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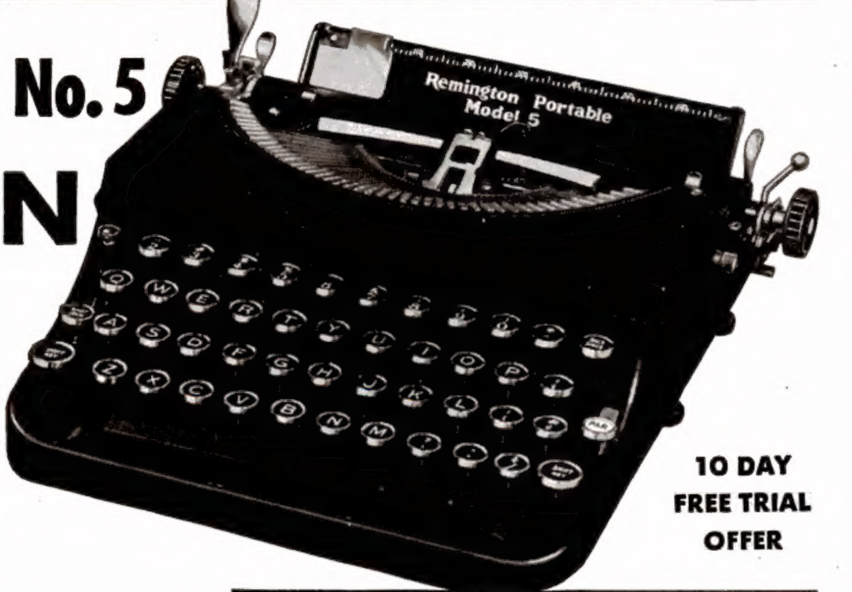

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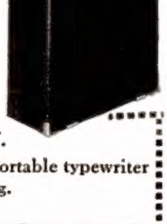

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Engineers Tell Why

NEW PLYMOUTH IS THE WORLD'S SAFEST LOW-PRICED CAR

First Car ever built on High-Speed Safety Principle

CHIEF ENGINEER Fred Zeder (center) and his colleagues, Carl Breer and O. R. Skelton. Five years ago they produced the first low-priced car with a Safety-Steel Body and Hydraulic Brakes . . . and now they've created the first High-Speed Safety Car!

Today's congested highways demand this New Kind of Car

ALL DRIVERS are hitting it up much faster than they used to. And there are almost twice as many of them on the nation's highways today as there were just 10 years ago.

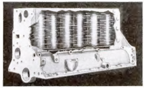
That gave Plymouth engineers their cue. America needed a different kind of automobile than had yet been built . . . a fast car, with the maximum of protection for its occupants . . . that is, a "high-speed safety car."

The engine is moved well forward . . . as first introduced by the famous "Airflow" cars.

So they started with the engine of the new Plymouth. They increased its power. And that worked both ways. It gave this new car greater speed, of course . . . but more, it achieved what engineers call "high mobility" . . . in other words, faster get-away and instantaneous response.

You'd naturally expect that this increased power would require more fuel. However, by improving the cooling system and the ignition timing, they actually *cut gas and oil consumption 12% to 20%!*

When you drive this car, everything you touch will have a different "feel." The clutch works easier. Syncro-Silent Transmission simplifies gear shifting . . . makes it effortless as well as noiseless.



Full-length water jackets and directional circulation reduce engine heat, save oil.

Even today, Plymouth is still the only low-priced car with Hydraulic Brakes.

But probably the biggest change you'll notice will be in the ride. Bouncing and jouncing have been definitely overcome by the new Plymouth's "Floating Ride!"

New weight distribution . . . the use of new-type Mola Steel front springs and a sideway eliminator . . . make you *glide* over the rough spots in the road.

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FEATURES AND DEPARTMENTS

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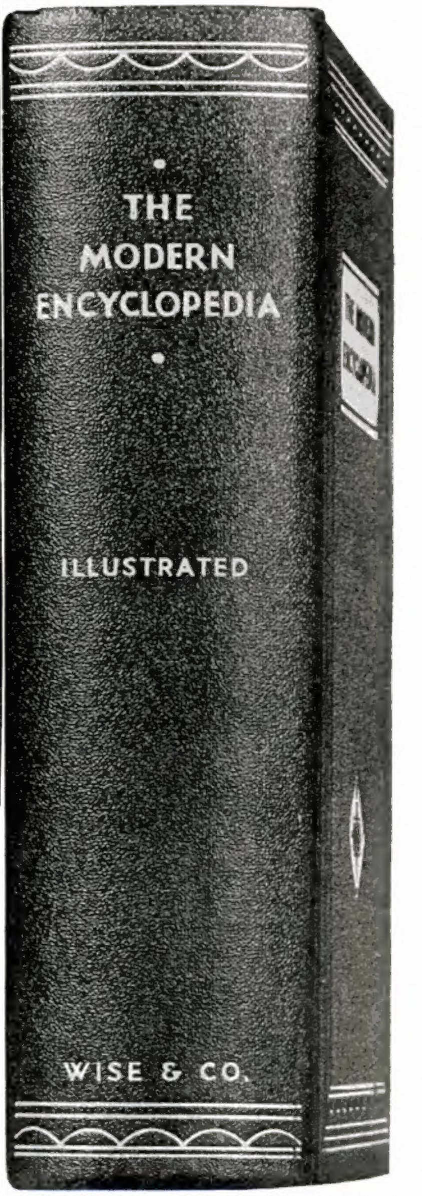

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POPULAR SCIENCE MONTHLY FOR MARCH, 1935

MODELS

NEW DEVICES FOR THE HOUSEHOLD

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PHOTOGRAPHY

UNUSUAL FACTS AND IDEAS

CRAFTWORK

WOODWORKING

IDEAS FOR THE HANDY MAN

In This Issue—Hundreds of Fascinating Articles Tell the Latest News of Laboratory Discoveries, Scientific Triumphs, and Amazing New Inventions

THE SPIRIT OF SERVICE

THE value of a nation-wide telephone service, under one unified system, is reflected in the day-by-day efficiency of your own telephone. It is given dramatic emphasis by an emergency.

Several years ago, the worst sleet storm in telephone history swept north from Texas almost to the Great Lakes and ravaged a section 150 miles wide. Thousands of telephone poles were broken. Thousands of miles of telephone wire were snapped by the weight of clinging sleet. Telephone communication throughout the country was affected by this gap in the Middle West.

To restore the service quickly was beyond the power of the local telephone companies. Had they been forced to tackle the job alone it would have taken months and imposed a heavy financial burden. Instead, the full resources of the Bell System were thrown into the breach. From the Southwest, from New York, Pennsylvania, Ohio and the Northwest, the repair trucks started rolling into the stricken area.

Even while men were on their way, the warehouses of the Western Electric Company started shipments of tools, wire, poles, cross-arms and other needed equipment. It was only because of standardized material and standardized methods that the emergency was met and service quickly restored.

Telephone service as you know it today would be impossible without the unified Bell System.

The Western Electric Company is the manufacturing, distributing and purchasing organization for the Bell System. Centralized activity of this kind means better quality at lower cost.

BELL TELEPHONE SYSTEM

Rusty screens can be cleaned with a solution that will not clog openings

Spring Repairs

FOR AILING HOUSES

By R. M. Bolen
Secretary, Popular Science Institute

ALTHOUGH crisp winds may still persist, March is the ideal month for starting spring repairs. Even the mildest winter takes its toll, and though you plan a fresh coat of paint or even a new roof, there are a score of other simple sprucing-up repairs that must be made to put your house back in shape.

If you were rushed last fall and simply stored your screens as quickly as possible to make room for storm windows, now is the time to go over them carefully. Screens that are torn or ripped should come in for first consideration. If the holes are not too large, they can be patched with squares of screening unraveled at the edges and interlaced into the original netting. Long tears generally can be mended by sewing the edges together with strands of wire pulled from a strip of unused screening.

Stains on the inner boards of the roof indicate leaks that should be fixed before the spring rains

If your screens are of the type that rust, your next job will be to brush them clean and paint them. Asphaltum varnish thinned with turpentine may be used, or regular green screen enamel can be purchased at your neighborhood hardware store. Boiled linseed oil mixed with a little turpentine and enough lampblack to give it color also forms an even-drying coating that can be applied with a close-grained sponge instead of a brush. This mixture can be used one year and spar varnish thinned with turpentine can be applied the next.

A trip to your attic in early spring will soon show you how your roof has fared during the winter. If there are leaks, the water from melting snows will have left its mark of discoloration on the inner boards. Mark these spots carefully and make repairs from the outside, locating the spots by having your neighbor rap on the inside of the roof with a hammer. Don't be surprised if you find the faulty shingles several feet above the location of the spot.

To repair cracked wooden shingles, cut strips from a sheet of asphaltum roofing, making them long enough to reach from the butt of the shingle to the first row of shingle nails and about five inches wide. Then simply lift the shingle by prying it up carefully with a screw driver, slip the strip under it so that it is centered on the crack, and hammer the shingle back into place. The heat of the sun will melt the asphaltum enough to make it stick.

Inspect the flashings around the chimney and vent pipes. Prepared cements can be purchased that will mend any leaks that may be present at these points. Also, go over your eaves troughs. Clean out the dirt and leaves that may have collected during the winter and fall and make sure that the down spouts make good connections with the drains.

In patching the cement work around your home, the secret of success lies in using good cement. The other ingredients —sand and gravel—also should be clean and free from clay.

To repair a break in a sidewalk, such as those caused by the heaving of frosted ground, first carefully remove all of the broken pieces. Brush the surface well with a stiff brush to make sure that even the smallest bits of loose cement have been removed. Soak it well with water; it not only helps to remove the dirt but also prepares the surface for the new cement. If the break is smooth, roughen the surface with a cold chisel to furnish a good bond.

FOR a small job, mix the cement by adding three parts of sand to one of cement. If a large repair is being tackled, a mixture of one part cement, two parts sand, and three parts gravel should be used. Measure them carefully, and mix them well before adding just enough water to make the mixture smooth but not too wet.

If the break is at the side of the walk, place a straight board along the edge to serve as a form and fill in the hole until it is level. Finally, sprinkle a little pure cement on the wet surface and trowel it smooth. To guard against freezing, cover the repair with burlap, straw, or manure.

When the ground is soft, put an end to porous cellar walls that are continually leaking dampness. Dig a narrow ditch around your house to expose the foundation and then apply two coats of hot asphalt or coal tar to the outside surface. Prepared coatings that can be applied cold also can be obtained.

An inexpensive, colorless solution for damp-proofing cellar walls from the inside can be made by dissolving paraffin in kerosene, using about one and one half pounds of paraffin for every gallon of the solvent. The kerosene should be warmed carefully to about eighty degrees Fahrenheit and the paraffin added in small bits. Naturally, extreme care must be used in both heating and applying the mixture.

VERY often, a leaky cellar wall can be traced directly to a crack. In this case, the home owner can put a Saturday afternoon to good use by chinking it with cement. Spray the crack well with water, and then stuff in a rich mixture of cement to which a small amount of lime has been added. Incidentally, hydrated lime added in the proportions of one part to every ten of cement will tend to make any mix more waterproof.

As spring gets under way, each week will present other jobs to the home owner. Shutting down of the furnace will call for a general cleaning and whitewashing of the cellar. Milder weather will allow interiors to be painted and windows to be glazed. And the end of the May rains will offer ideal weather for painting the outside trim.

How a Man of 40 can

RETIRE AT 60

BY INVESTING $1.77 A DAY

STRANGELY enough, the cost of retiring on an income seems to bother some people.

It shouldn't.

If you save even as little as 18c a day, you can have a small but regular income paid you in your old age.

Or save $1.77 a day as mentioned above, and naturally you get ten times as much income when you retire. Save more and get more.

What it costs to retire is not as important a question as *how much income you want each month when you're 55 or 60 years old.*

Here's what most men want

Generally when a man gets to be around 40 years old, he knows he has only about fifteen or twenty more active years left in which to save for his old age. He knows he has about fifteen years after he reaches 60 for which he must save in advance—or accept charity.

How much does he need? $25 a month for life? $100 a month for life? $250 a month for life?

He knows ordinary methods of saving are both slow and risky. He dare not spend his capital for fear of using it up too fast. He doesn't know how long it will last. Thus he may be facing poverty in the years he needs money most.

Here is why the Phoenix Mutual Retirement Income Plan is better for the man who wants a simple way to have plenty of money when he retires.

1. You get a regular monthly income for life when you retire: $10 a month, $50, $100, or even $500 (depending on the Plan you select). You can arrange to retire at 55, 60, or 65.

2. When you retire by this Plan, you *never* face poverty as long as you live. You *always get* money every month.

3. Leave your wife a cash income for life in case of your death before retirement age. (You can add this provision to your Plan if you are insurable, and also add the following:)

4. A monthly disability income for yourself, if before age 55 serious illness or accident lays you up for six months or more.

Isn't such a plan worth having?

The best of it is, *anyone* can afford to invest something regularly when the reward is the chance to *retire for life!*

How to Select the Right Plan

To find the cost of the Income Plan which best meets your own needs, first decide when you want to retire, and how much income you will want each month after retirement. When we know this and your present age, we can tell you the cost to the exact penny. And usually every cent, and more in most cases, comes back to you at retirement age.

Write your name and date of birth in the coupon below and send it today. We will mail you an interesting illustrated 24-page booklet which tells all about the Phoenix Mutual Retirement Income Plan and how it works. You will be mailed a copy without cost or obligation. Send for your copy now. The coupon is for your convenience.

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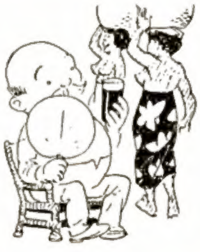
Our Readers Say

Java Has Everything —Except Home Workshops!

I am living as a doctor on beautiful Java, in the rather large town of Semarang, population 250,000. We have everything here—lots of interesting medical work, and in the evenings concerts, movies, clubs, and other entertainment. But—nobody is interested in a home workshop. The general belief is that the heat is too great, which it is not, as it never exceeds ninety-three degrees. I am the only amateur here who possesses a real photographic dark room, of which I am rather proud. Popular Science Monthly is very much in favor in Semarang. If you could publish an article on glass blowing, I would be very much obliged.—P.V.O., Semarang, Java.

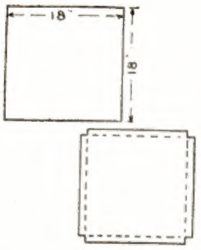


It's a Slow Bullet but It Would Get There

In answer to the problem submitted by B. H., Georgetown, Ky., I would say that if the train were traveling at the rate of fifty miles an hour and a bullet were fired from the caboose toward the engineer's cab, and the bullet traveled at exactly fifty miles per hour, it *would* reach the cab. The bullet, being fired from aboard the train, is already traveling fifty miles per hour even before it is fired. When it leaves the barrel at a velocity of fifty miles per hour, that speed must be related directly to the train. The bullet will therefore be traveling at 100 miles per hour with reference to the ground and fifty miles per hour faster than the train. It will reach the engine cab in the same length of time it takes the train to progress the same distance. Perhaps, with some encouragement, B.H. will give us a real problem.—F.C., White Plains, N. Y.

Getting the Most Out of a Piece of Tin

Here is a sensible problem for a mathematician: I have a piece of tin eighteen inches square. I want to make from this tin a water container that will hold the greatest amount of water possible. What size would the container be, in height and width? Also, what size squares would have to be cut out and wasted? Many of your readers will be able to work this out—maybe. Some say that the height and width have nothing to do with it. They are wrong. Others say that if only one square inch is cut out of each corner, the resulting container will hold most. They, too, are wrong. This problem is a little more difficult than the one about the wire stretched around the earth. How many can solve it?—H.M., Utica, Mich.

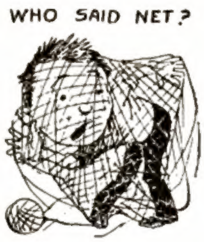


But How Could We Make the Bugs Tune In?

In a recent issue you published an article about killing insects with radio waves, and another about killing germs in decayed teeth by the same method. Why could not radio waves be utilized to kill all the insects, germs, and other pests that we have to contend with? Maybe the waves could be sent out at long range without the use of electrodes, clearing large areas of pests at one time.—T.H., Dayton, Ohio.

Now That He Has the Boat, He Wants a Shrimp Net!

I have just completed and launched the general utility rowboat for which you published plans in your August issue, and I must say that I am more than delighted with the results. She rides well in the water and floats as lightly as a canoe. You are certainly to be congratulated on the splendid design. I have not had a chance yet to try her with a motor, but I can see from the way she handles with the oars that a light twin will make her split the water. We fish in salt water off the coast of Georgia, using live shrimp for bait, and a shrimp casting net is almost an essential part of our equipment. How about running an article showing how to make one? They are equally good for casting for minnows. I am also interested in a small cabin cruiser, say twenty-four feet long, of shallow draft yet seaworthy enough to take out on fair days ten or fifteen miles to the gulf stream. I know you would find many readers interested in such a craft. It could be powered with a converted V8 Ford motor, or even with a model A, and would do eighteen to twenty-five miles an hour under favorable conditions. When you get around to it, have your designers give us plans for it.—H.O.R., Atlanta, Ga.



Microscopists, Attention! Here's an Easy One

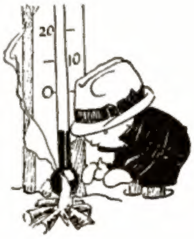
In some stagnant water I was examining under the microscope, I saw a long, transparent, wormlike creature that was blunt on one end and tapered down to a fine point at the other. It had organs running from the interior end to a point midway of the tail. I wonder if some reader could help me out in identifying the creature.—W.C.M., Peoria, Ill.

This Sounds Like a Corking Good Idea

Here's a hint for the amateur chemist whose cork stoppers are eaten away by lye: Take a cork that fits the bottle and make a plaster mold with it. Fill the mold with melted lead, and when it is cool file the lead stopper smooth. This stopper will resist the action of lye. How about plans for a microtome fitted with an old razor blade, and instructions for using it?—L.J.L., Philadelphia, Pa.

Some Competition for the Weather Man

I read your recent article on "Making a Wind Gauge" (P.S.M., Jan. '35, p. 64) with great interest. I have been thinking for some time of setting up a home weather bureau, and this gives me my first opportunity to get started on it. It seems to me that with a little practice we amateurs ought to be able to hit a better average than the professionals who guess for the newspapers. I hope you will publish more information on weather, describing such instruments as a recording thermometer, mercury barometer, hygrometer, and seismograph. I would also appreciate suggestions as to any instruments I will need to buy, and where they can be purchased.—H.S., St. Louis, Mo.



This is to express our appreciation of the article on the homemade anemometer, in the January issue. In our work of gliding and soaring, the weather plays a highly important part. We recently found that an anemometer was a necessity, and were about to go to work to design one for ourselves. Your instrument just fills the bill.—Intercourse Glider Club, Intercourse, Pa.

Try to Thrill a Microscopist With a Racing Car!

I agree with Miss M.D.M., of St. Augustine, Fla. Why not put in more articles on machines? Chemistry and microscopy are very interesting subjects, but they don't give you the thrill of seeing your first engine run or driving your homemade car. Why not give us some dope on racing cars? I've been fooling around with one and have had a lot of fun.—R.S., Hanover, N. H.

A Britisher Must Have His Umbrella, Even at a Fire

A recent issue of Popular Science Monthly showed London firemen using asbestos suits and umbrellas for protection against sparks and brands. Having once held the business end of a fire hose (while the regular fireman picked himself up off the ground), I have grave doubts of the practical value of the umbrellas. Wrestling with a hose with pressure around a hundred pounds, a fireman has neither time nor arms to spare for holding an umbrella. London firemen can have their asbestos umbrellas;

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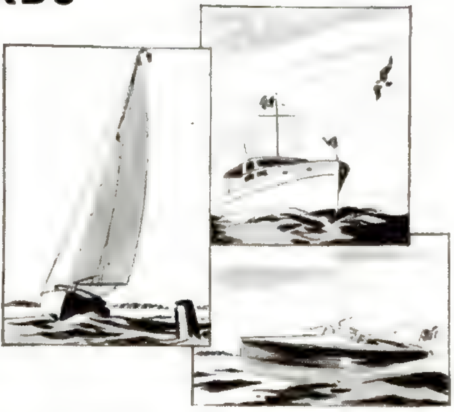
•To qualify you must send in the entry blank with all questions answered.
•To have your entry considered for the awards you must conform to the rules which will be mailed to you.

Good luck to you!



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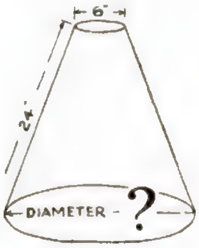
give me a high-pressure hose. Of course, asbestos suits have long been used for rescue work in the navies of the world.—P.G.D., Chicago, Ill.

One Good Problem Just Leads to Another

Looks like the boys in Our Readers Say are going in for some heavy mathematics. More power to them—and please print some more problems. We can take it. I'll help the work along with the following: A frustum of a cone has a slant height of twenty-four inches and upper diameter of six inches. What should be the diameter of the base to give maximum volume to the frustum? Throughout the depression I have always managed to scrape up enough money to buy Popular Science Monthly. I just couldn't miss Our Readers Say with its interesting problems.—F.L.M., Aurora, Ill.



Knowing What To Invent Is the Inventor's Business

There's just one thing wrong with the suggestion of V.E.H., Los Angeles, Calif., that you start a "What To Invent" department. Knowing what to invent is what inventors really get paid for; once the need is seen, almost anybody can figure out how to meet it. For example: I had long been irritated by the paper wrappers you find on lumps of sugar in some restaurants. To peel off the wrapper, you had to get your finger nail under the overlapping edge of the paper. I suppose everybody else had experienced the same inconvenience, but nobody did anything about it, apparently accepting it as one of the irritating things in life. Then suddenly, one day, in my favorite restaurant, I discovered that the wrappers had changed. There was a projecting tab on the overlapping edge, making it an easy matter to grasp it and tear it off. Simple, wasn't it? Somebody had just used his noodle. But the real work was in seeing that something *could* be done about the matter. If anybody had thought to list this in a "What To Invent" column, he could have gone on himself and worked it out. The best thing for the would-be inventor to do is to cultivate the mental habit of always asking himself, "Isn't there a better way to do this?" —D.M., New York City.

Regardless of Physics, It's Bad Table Manners

I have a problem which has proved a hard one for both me and my dad. Any physicist will tell you that when you put a cork loosely in the neck of a bottle and then exhaust the air from the bottle, it is the pressure of the air on the outside, and not the suction on the inside, that pushes the cork in. But how does this principle apply when you suck up a string of spaghetti into your mouth? It doesn't seem possible that the pressure on the outside could push it in. If the pressure were exerted on the end of the string, it would crumple up. If the spaghetti were pushed on the side, it wouldn't get anywhere. It couldn't be pushed on both side and end, because it's hanging limp. So how come? I wish somebody would give me a lift on this problem, for the sake of my peace of mind.—J.L.P., Geneva, Switzerland.

A Reader Rallies to the Defense of Darwin

I would like to say this much in defense of Darwin's theory against the attack of L. S.B., of Fullerton, Calif.: In the first place I cannot see where he offers any substantial argument against Darwin's theory. Darwin's theory deals with life and not with the material of which life is composed. Chemistry, as well as physics, is a study of natural laws, and a study of how man may use them to his own advantage. Water is a natural compound because the valence of oxygen is two and the valence of hydrogen is one. Thus water is composed of two volumes of hydrogen to one volume of oxygen. Valence is a natural law that states whether or not two elements will combine, and if they will combine, in what proportions. Because of this, water is the same today as it was millions of years ago when the earth was a mass of molten rock being torn from the sun by a passing celestial body. Suppose that these natural laws did not hold true. Water might one day be hydrogen peroxide, and the next day it might suddenly turn into its respective gases and disappear into the atmosphere. Darwin said that over long periods of time animals and plants either developed or degenerated according to their environment and the amount of competition each encountered in its life. He also said that organs were developed according to whether or not they were needed. In this manner the lizards who had developed a liking for jumping through the air either while playing or while hunting, found through the course of ages that their scales were gradually turning to feathers. I hope that what I have said shows that chemistry and evolution can in no way be connected with each other. The existence of the animal and plant life that we have today is entirely dependent upon the stability of the laws of nature.—F.H., Fort Wayne, Ind.

There's No Frustrating This Math Shark

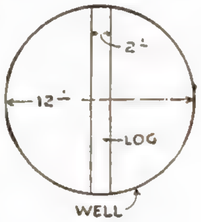
Those problems in mathematics handed out by E. A., Sault Sainte Marie, Mich., were A-1 muscle builders in pencil-pushing. I refer to the "helix on a frustum of a cone" and the physics problem in heat absorption. On the helix, I finally obtained a formula for accurate results only after integrating the polar coördinate formula for length of an arc of any curve. My answer turned out to be 235.99 inches, for the length of helix. The flat development of the surface shows a curve of the spiral family. In the physics problem of the steel cube placed in the hot oven, the fact that the flow of heat into the cube slows up continuously as the difference in temperature between oven and cube approaches zero, means that the cube never does reach the exact temperature of the oven; the time is infinity, theoretically.—W.H., Detroit, Mich.

Inventor Finds the Answer to a Housewife's Prayer

The Texas housewife who "put the inventors on the spot" in Our Readers Say recently, can have one of her wishes filled. She demanded a non-droppable coat hanger; well, I have the coat hanger that she and many other housewives have been looking for. After repeating the daily exercise of picking up coat hangers for years, I devised a hook that will stay on the pole, rod, or clothesline. It does not require any extra clamps or springs. In the past year I made several of them for people in the neighborhood, and they say the device works fine. I am now arranging to have it manufactured and marketed.—J.P.D., Milwaukee, Wis.

It Might Be Easier To Dig Somewhere Else

I have been afraid for some time that some math bug would send in the problem about the horse in the circular field and that I would not have the will power to leave it alone. The solution involves calculus (and, of course, analytical geometry, trigonometry, algebra, geometry, and arithmetic) and for that reason I do not believe that a detailed solution here is practical. A length of 180 feet for the rope will give an area that is correct to about four tenths of one percent. Since the solution of the equation obtained by integrating is a cut-and-try, or "Newton's method" solution, I left it at 180 feet rather than carry it further. Now *I'll* ask one: A man digs a well twelve feet in diameter and in doing so finds a log two feet in diameter lying directly across the center of the hole. What is the volume of the section of the log that he has to cut out in order to dig the well through it and complete the job?—J.J.T., Shadyside, Ohio.



More Kind Words for the Vapor Buggy

I saw the request of F.H., Lincoln, Kans., for an article on steam-driven automobiles. I have been wondering a lot myself about why they are not being used now, and would like to see an article on them. To my mind, the great handicap of the steam automobile is the difficulty of generating steam in a mobile unit. The steam engine is really simpler and requires less parts than an internal-combustion engine.—L.C., Memphis, Tenn.

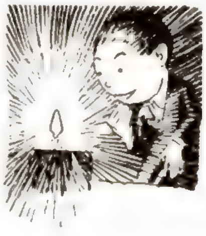
Like F.H., I am a steam-automobile enthusiast. I know from experience of the advantages of this form of power for automobiles, having formerly owned a car of this type.—F.R.V., Baltimore, Md.

And California Is Still To Be Heard From

Let G.S.L., of Newcastle, Australia, who boasts of fifteen days of fine weather, meditate upon this: At a Civilian Conservation Corps camp here at Tucson, where outdoor work is done exclusively, they lost only three hours of work all last winter (from September to June) on account of bad weather.—G.H.R., Tucson, Ariz.

A Late Flare-up of the Christmas Spirit

Maybe some of your readers can explain this: While experimenting with a Ford spark coil, I connected up a burned-out Christmas-tree bulb to the secondary terminals. The filament in the bulb was perfect except for a small break about one fortieth of an inch wide. Of course, this rendered the bulb inoperative. When I switched on the current, the bulb glowed with a weird blue light. This glow extended from the base of the filament to the place where the break was. Is this due to some kind of gas inside the bulb? If not, what caused it?—J.R.B., Windsor, Conn.



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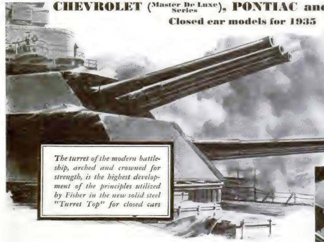

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FISHER engineers have realized for years that a *roof of steel* was the desirable thing for the modern closed car. Yet no one had ever successfully created such a roof. It involved new methods, new principles, the designing of vast new presses.

Huge sheets of tough, seamless steel had to be drawn and fashioned into these beautiful, protective roofs.

Now, success has crowned Fisher efforts. The safety steel roof *has been perfected* and named the "Turret Top" from its resemblance to the armored battleship turret.

This roof is all steel — even to the bows — and is unit-welded to the steel body panels. It is also singularly smart and graceful — and scientifically insulated against heat, cold, drum, rumble, rattle or noise of any kind — even at high speed.

We regard it as the greatest advance in motor car safety in a decade—and one of the greatest advances in smartness also.

Of course there are other worthwhile advantages in Body by Fisher for 1935 — Fisher No Draft Ventilation is as important as ever — and you will find full streamlining, more luggage room, windstream V-type windshield, wider seats, more headroom, bigger doors as well.

But the most vital advance of all is the new solid steel "Turret Top" —introduced on the new Chevrolets (Master De Luxe Series), Pontiacs and Oldsmobiles — and found, *like Body by Fisher,* ONLY *on General Motors cars.*

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POPULAR SCIENCE Monthly

MARCH 1935 VOL. 126 No. 3

RAYMOND J. BROWN, Editor

A helicopter in full flight. This is the machine built by De Bothezat for experiments sponsored by the U. S. Army. It made a speed of thirty miles an hour

Planes That Go Straight Up

OPEN NEW FIELDS FOR AVIATION

AMONG the skyscrapers of lower New York City, a few weeks ago, a strange wingless craft drifted down in a vertical landing. Its wheels touched the concrete of a pier and rolled less than a dozen feet. With balancing wings eliminated, it represented the latest style in autogiros. The flying windmill has taken another step toward the goal of a thousand inventors, the helicopter.

An autogiro can descend vertically; but it can take off only after a run. A helicopter could get out of a field the size of its landing gear. It could climb straight into the sky, could hover like a humming bird, and could drop like an elevator descending its shaft. Entirely new realms of aerial travel await the perfection of such a craft.

Military observers could dart into the sky, sidestep diving pursuit planes, and plunge to a landing; private ships could be housed in rooftop hangars shaped like water towers; office buildings could be capped with honeycomb cells holding the

By EDWIN TEALE

A wingless autogiro photographed on a pier at the foot of Wall Street, New York City, where it landed after a flight from Philadelphia. It later took off from the same spot

This strange contraption is a helicopter laboratory on wheels, used at the Institute of Aerotechnics at St. Cyr, near Paris, France, to study the problems involved in vertical flying

helicopters of the workers, each craft dropping into its compartment in the morning and rising straight up from it at night; aerial shuttle lines could link centers of population with airports and suburbs. These are not fantastic visions. They lie entirely within the realm of possibility. And it is such possibilities that spur on the inventors of many lands.

As these words are being written, a cable from England tells of dramatic progress. Mechanics at the famous Blackburn airplane works are busy assembling a huge craft of revolutionary design. Invented by Oskar Asboth, former director of a government research laboratory in Austria, it is designed to climb vertically to 10,000 feet and to attain a cruising speed of 110 miles an hour.

A single-seated experimental model of similar design is said to have made 200 flights without a mishap. Secret tests were carried out by Capt. R. N. Liptrop, a technical official of the British Air Ministry. He reports the ship climbed straight into the air at a surprising rate, that it maneuvered under perfect control, hovered over one spot, and landed gently at the end of each flight. On several occasions, he soared over the trial field with his hands off the controls. A mechanic, who had never piloted an airplane in his life, is reported to have taken the new craft up without the least difficulty.

All over the world, aeronautical experts are eagerly awaiting the tests of the new machine now nearing completion. Twin, motor-driven screws, cutting through the air in opposite directions, will lift the craft while a third propeller pulls it forward. This propeller is thrown in and out of gear by a clutch in the cockpit. Because the machine descends vertically, landing wheels are unneeded and the curious skycraft comes to rest upon four inflated pads which act as shock absorbers. In the event of engine failure, a self-spinning feature of the variable-pitch lifting screws is said to prevent a fall. Speed and load tests will soon reveal how far the new machines goes in rivaling the ability of orthodox planes. A second helicopter of like design is reported under construction in Austria.

To the average person, that item meant little. Political news crowded it from the front page. But to those who recall the long trail inventors have followed, searching for the goal of vertical flight, it was a thrilling story.

For five centuries, since the days of Leonardo da Vinci, the genius of the Renaissance, men have been striving by means of a host of mechanisms to lift themselves vertically into the sky with heavier-than-air machines.

It was a toy helicopter that first interested the Wright Brothers in aviation; it was the helicopter that Thomas A. Edison maintained throughout his life would be the ultimate craft of the sky; and it was the helicopter that such men as Peter Cooper Hewitt, inventor of the mercury arc lamp, Louis Brennan, inventor of the Brennan torpedo, Emile Berliner, father of the microphone, Edison, and others, spent years trying to perfect.

Among the papers left by Da Vinci at the time of his death in 1519, was the drawing of a proposed aerial craft which was to be lifted by "a great screw turning on a vertical axis." Three centuries later, a Frenchman, named Pauceton, designed a machine for navigating the air. It was to have "two turning mills, one to support the apparatus, the other to drive it along. A few years afterwards, Launoy and Bienvenu, fellow-countrymen of his, exhibited a flying toy. Two screws, formed by four feathers and turned in opposite directions by rubber bands, carried it aloft.

In place of rubber bands, Enrico Forlanini, an Italian, used a midget steam engine which he designed about the time of the Civil War. His model helicopter, driven by its puffing power plant, actually rose from the ground and flew. But his design was never translated into a full-sized machine.

The gap between the model and the man-carrying craft is tremendous. Hundreds of patents have been granted to inventors for helicopters that appeared sound on paper. Models have pulled aloft weights that, increased proportionately for big machines, would have equalled 100 pounds lift per horsepower. But the complicated mass of tubing and guywires, engine braces and transmission shafts, balancing flaps and propeller braces, have piled up the weight and increased the danger of breakdown in the big machines.

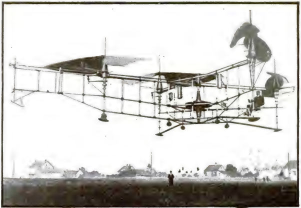
EARLY innovators like Edison and Emile Berliner were handicapped by heavy engines. Edison's weighed almost fifty pounds per horsepower. If, he said, motors could be built weighing only three or four pounds per horsepower, vertical flight would be simple. Today, we have air-cooled aircraft engines that develop a horsepower for every pound and a half of weight.

By 1907, motors had been improved greatly and that year stands as a landmark in helicopter history. In France, two machines carried their pilots into the air. One was designed by Paul Cornu, the other by Louis Breguet, later famous as a designer and builder of airplanes. It was one of his

The Curtiss-Bleecker helicopter, an experimental model produced in the United States at a total cost of $250,000. It has four lifting blades, each with a propeller to help keep the aerial windmill turning ships that, in 1930, carried Capt. Dieudonne Coste and Maurice Bellonte 4,030 miles on the first westward transatlantic flight linking Paris and New York.

Cornu's machine had cloth-covered, paddle-shaped blades. The power was transmitted to them by leather belts running from the engine. This fact, during one of the early trials, gave the inventor an exciting few minutes. Only the quick wit of his brother saved him from disaster.

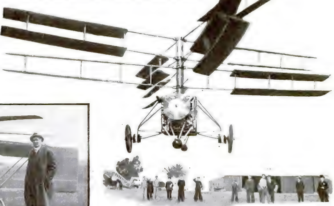
As the craft nosed from the ground, the belt to the rear lifting blades began to slip. The blades slowed down. The front of the machine reared higher and higher into the air. A moment later the whole apparatus would have crashed over in a backward somersault had not Cornu's brother leaped up, caught the forward framework and, dangling from it, restored balance until the machine could settle to a landing.


Etienne Oehmichen, French aviator, making a successful rise off the ground in his helicopter. He made a circular flight of five eighths of a mile and landed in safety

FOUR biplane blades lifted the huge machine constructed by Breguet. On August 24, 1907, with the motor volleying like a machine gun and the blades threshing the air, the awkward craft lifted its inventors several feet from the ground, then dropped back to earth.

About this time, inventors all over Europe were tinkering with helicopters. One was a young Russian, now world-famous as a designer of huge multi-motored flying boats. In 1908, Igor Sikorsky finished a machine near Moscow. It had a fifteen horsepower engine and twin lifting propellers whirling on a concentric shaft. The engine was too weak. At the trial, the machine buzzed like an infuriated bumblebee, but hugged the ground.

Undiscouraged, young Sikorsky persuaded his father, a professor of psychology at Moscow, to venture more rubles on a second machine. It had a stronger motor and on several occasions rose into the air carrying ballast instead of a pilot. Controlling it by long strings, young Sikorsky ran alongside as the helicopter made flea-like hops over a level field. Shortly afterwards, he turned his attention to airplanes and these early adventures with helicopters are little known.



Above, the Marquis de Pescara rides a helicogyre into the air at Barcelona, Spain. He later set a world's record with a flight of half a mile in this machine. Left, one of the early experimental helicopters of Emile Berliner. This machine lifted its own weight

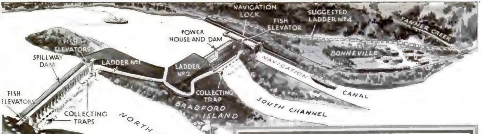
The World War saw a curious adaptation of the helicopter idea, a "flying tin can" which carried observers aloft over the Austrian trenches. Three motors, reënforcing each other, delivered power to twin lifting screws. Above the framework was a cylindrical turret, suggesting a tin can, which housed the observers. The whole craft was operated like a captive balloon, rising at the end of a cable and being pulled down from the sky by means of a winch. Known after its designers as the Petroczy-Karman helicopter, it rose on a number of occasions to heights of a hundred feet and more.

HOWEVER, the men who rode it never attempted to bring it to earth by throttle control. They always let the cable pull them back to earth. Thus, the machine contributed little to one of the biggest problems of the helicopter, the problem of landing safely, especially if the engine fails.

As a matter of fact, designers have found it easy to get off the ground. The hard nuts to crack have been maintaining balance in the air and descending safely.

To keep on a level keel, some machines have had the opposing propellers tilted toward each other. Others have had the whole mast upon which the air screws revolved designed so it could be tilted in any direction. Still others have had small auxiliary blades spinning at the far corners of the apparatus to lift or depress as the pilot wished. Variable-pitch lifting screws, which can be changed to regulate the "bite" they take out of the air, and consequently their lift, form a fourth solution which has been advanced by innovators. Nearly all the helicopters which have been produced have had the engines and pilots placed low to provide a pendulum effect that would aid in maintaining balance in the air.

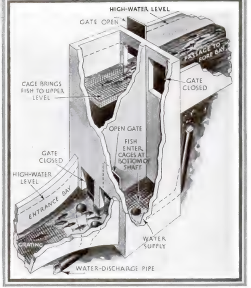
So far, no helicopter has flown on a gusty day and no helicopter has landed safely from any height with its engine dead. Unless the machine can *(Continued on page 116)*



This drawing shows the proposed dam in the Columbia River at Bonneville, Ore., with ladders and locks to carry the salmon run across it

Elevators for FISH

TO SAVE SALMON CANNING INDUSTRY



The construction of the fish locks is made clear by this diagram. They operate on the same principle as navigation locks

WHEN the Federal Government recently decided to build a seventy-two-foot power and navigation dam near the mouth of the Columbia River at Bonneville, Ore., the members of the commercial fishing and fish canning industries had a few questions to ask.

"What is the government going to do about the salmon run?" they demanded. "Don't they know that every one of the many millions of salmon that enter the Columbia River each year will have to get over that dam to reach their spawning grounds, or there won't be any Columbia River salmon industry in a very few years?

"That annual run of salmon is worth anywhere from five million to ten million dollars. Twenty thousand people are dependent on it, directly or indirectly, for their living. And it won't be only the salmon canning industry of Oregon and Washington that your dam will ruin. It will ruin salmon fishing all along the Pacific Coast, because the Columbia River is by far the most important spawning stream for the Chinook salmon caught by trollers all the way from Juneau to Monterey. If they can show us how they are going to make those millions of migrating salmon hop over that seventy-two-foot dam, we'll start cheering for their Bonneville project."

The government engineers passed along the job of "showing" the fishing industry to the scientists of the United States Bureau of Fisheries.

Those scientists do not as yet know *all* about the several varieties of salmon that are important commercially in the waters of Alaska and of the Pacific Coast States, but they have been studying them for a good many years, and they have found out enough about their life cycles and their habits to be able to forecast the catches of future seasons with astonishing accuracy. For example, they predicted that 1934 would be a big year, and last summer the salmon came into the rivers in such numbers that Alaska canners packed 400,000 more cases of fish than they did in any other year on record!

They know that young salmon stay in fresh water for one or two years, and then go down to the sea. They know that two, three, or four years later—usually two years later—those that have escaped the perils of deep-sea life return to their home rivers to spawn and then to die.

By ARTHUR GRAHAME

After spending several days last summer watching tremendous numbers of these fish fighting their way up shallow and rocky tributaries to reach their spawning grounds, Elmer Higgins, chief of the Bureau's division of Scientific Inquiry, remarked that this migration of salmon was the most impressive demonstration of the biological urge that he had ever observed. Homeward-bound salmon will fight to the last ounce of their rapidly diminishing strength—they cease feeding when they head for their last roundup, and live on their stored energy—to reach their spawning places. They will battle gallantly against the swiftest currents. They will leap out of the water to get over low falls that bar their way. But they can't leap over a seventy-two-foot dam!

After studying the problem carefully the Bureau's scientists presented their solution. They would provide a ladder up the face of the dam for the salmon to climb. And if the fish didn't take to the job of climbing the ladder, they would take them to the top of the dam in elevators!

Fish ladders have been built and operated successfully in the past, but never one of even one twentieth the size of the giant fishway that will take the great Columbia River salmon run safely over Bonneville Dam.

As you will see in the accompanying drawing, at Bonneville the Columbia River is split into two channels by Bradford Island. On the south shore there will be a navigation canal and locks, and a six-unit power dam will span the south channel. Across the north channel will be built the seventy-two-foot spillway dam—a low-crested structure with eighteen gates that can be raised above water level, leaving little obstruction to the river's flow at the time of the tremendous spring freshets for which the Columbia is famous.

Harlan B. Holmes, associate aquatic biologist of the Bureau, was placed in charge of designing the fishways, in coöperation with the dam's engineers. First of all, he had to devise a way of trapping the salmon at the foot of the power-house and spillway sections of the dam. He knew that the efficiency of the fishways would depend to a large degree on the probability of a salmon finding a "this way up" sign as soon as it approached the obstruction, and that a "this way up" sign to a homeward-migrating salmon would consist of an opening through which a considerable volume of water was discharging. So, as shown in the drawing, the collecting traps will extend across each section of the dam, and are provided with numerous entrance weirs through which water flows swiftly.

When the fish were trapped, they would have to be induced to climb the ladders provided for them. To do this, conditions would have to simulate the natural conditions that salmon face in ascending rapids—a series of pools, with swiftly flowing water connecting them. The concrete fish ladders shown in the drawing solved this problem. The water in the pools formed by the various chambers will vary from five feet to ten feet in depth. The column of water flowing down the ladders always will be of sufficient depth to allow the fish to swim through it, so they will not have to jump a series of falls.

Ladder Number One leads over Bradford Island from the south end of the spillway trap, and on the island joins Ladder Number Two, which leads from the north end of the power-house trap. After joining, they discharge into the pool above the power house. A third ladder, leading from the north end of the spillway trap and discharging into the channel above it, probably will be added as a safety precaution, and a fourth may go around the dam on the south side of the river.

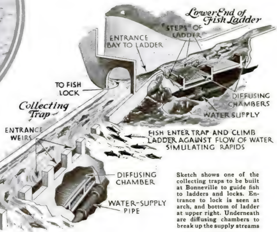
To most salmon-wise people these fish ladders seemed to be all that is necessary. But Holmes, knowing that the very existence of an important industry depended on getting the salmon over the dam, refused to take chances. Perhaps, after entering the traps at the foot of the dams, the salmon would refuse to climb the ladders, or would be too weak to do so. So he included elevators for them in his scheme.

Pairs of fish locks, a good deal like navigation locks, will be built at the south end of the power-house trap, and at the north end of the spillway trap. They are designed for

(Continued on page 124)

Brailing up salmon from a floating trap in one of the fisheries of Alaska

In circle, Bureau of Fisheries workers tagging weakfish in North Carolina. Above, a new type of soft rubber tag for marking trout, showing how it is inserted in a fish

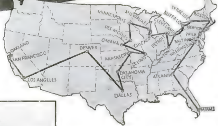


Sketch shows one of the collecting traps to be built at Bonneville to guide fish to ladders and locks. Entrance to lock is seen at arch, and bottom of ladder at upper right. Underneath are diffusing chambers to break up the supply streams

Wire Photograph Service Spans Nation

News photograph wrapped around lateral surface of cylinder, is being inserted in transmitting machine for dispatch to forty-six newspapers in distant cities

So THAT readers may get pictures of distant events with their news, instead of hours or days later, photographs for forty-six newspapers are being flashed electrically over a 10,000-mile "wirephoto" network just placed in operation by The Associated Press. The nationwide system links twenty-four cities where stations have been established both for sending and receiving pictures by wire, and is coordinated from a control station in New York City. To open the day's schedule, New York calls all stations by 'phone and finds what pictures they have, and the order of transmission is decided according to relative news importance. Each station, in its assigned turn, places its picture upon a transmitting machine, and the twenty-three other stations in the hook-up receive the photograph simultaneously. Pictures coming in from hour to hour during the day are similarly handled. Often sixty or more are transmitted daily. The apparatus applies a standard principle. Synchronized revolving cylinders at sending and receiving ends carry, respectively, the original picture and a sheet of sensitized paper. An electric eye scans the original and translates its light and dark portions into electric impulses that actuate a flickering beam of light in the receiver and impress the image on the sensitized sheet.

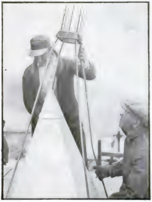


Zig-zag black line upon map at right links key cities which Associated Press now serves with news pictures over wire

In lightproof case, picture leaves receiver

THIEF STEALS RODS OFF WASHINGTON MONUMENT

ONE OF the strangest thefts on record was revealed recently with the reported disappearance of 107 miniature lightning rods that were being substituted for older ones atop the Washington Monument. Apparently an audacious thief had taken advantage of the huge scaffold used in renovating the monument to commit one of the loftiest of burglaries. Plated with gold and tipped with platinum to avoid corrosion, the rods were valued at eight dollars apiece.



Workmen replacing stolen lightning rods

TOWER IS SCHOOL FOR PARACHUTE JUMPERS

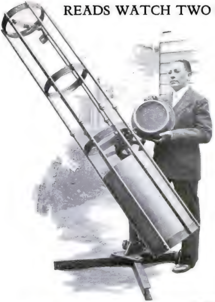
So THAT novices may learn the sensations of parachute jumping and acquire confidence before they venture to leap from a plane, the Soviet government has established a training tower at Moscow that is believed to be the first of its kind in the world. A spiral stairway leads to a jumping platform at the top, where the tyro adjusts the harness of a permanently open parachute and leaps into space. A wire cable checks his descent for safety.

GNAT-POWER MOTOR RUNS ON ENERGY OF SUNLIGHT

Motor seen below is run by ray of electric lamplight

DEMONSTRATING what progress has been made thus far in attempts to harness the energy of the sun's rays, General Electric Company engineers recently exhibited four small cells of platinum-coated selenium that have the power of converting sunlight into electricity. Even the light of a seventy-five-watt lamp causes the bank of cells to generate enough current to run a tiny motor rated at four ten-millionth of a horsepower. Inventors seek still more efficient means of capturing sunshine.

READS WATCH TWO MILES AWAY



A HOMEMADE telescope, recently completed by an amateur astronomer in Chicago, is so powerful that by its aid its builder can, he claims, read the time on a pocket watch at a distance of two miles. The builder, who is a printer, did the whole job himself, even to grinding the concave reflecting mirror. The barrel of the instrument consists of a framework of pipe, joined at half the length by union connections. When these unions are unscrewed, the top half of the barrel may be folded back, making it possible to store the telescope in a limited space. Although the instrument weighs 500 pounds, wheels attached to the stand permit it to be moved about with comparative ease. In the photograph at the left, the builder is shown beside the telescope holding the homemade reflector, which represents the most difficult part of the job.

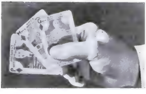
SALVAGE MEN CLIMB UP TO DISMANTLE A WRECK

FRENCH salvage engineers are tackling an unusual job in the Mediterranean. The *Nicholas Paquet,* a vessel plying between Marseilles and the coast of Morroco, grounded on the rocks, and remained with its stern rearing high in the air and its bow buried in the waves. Salvage men climb to the tilted decks on rope ladders and lower dismantled parts of the vessel to waiting ships.

FIRE TRUCK PUMPS COMPRESSED AIR

Firemen with masks for breathing compressed air from pump

PUMPING air instead of water, a new truck recently added to the San Francisco, Calif., fire-fighting equipment supplies fresh air to men wearing masks and compressed air to special hammers employed in cutting through floors and walls. A special reducing valve on the fireman's belt makes it possible for him to adjust the amount of air passing through his mask, diminishing the pressure for breathing purposes. As a safety feature, an automatic check valve is built into the mask. It closes if the air supply is cut off or stopped. In such a case, a special canister of chemicals purifies the air breathed by the fire fighter until he can get out of the danger zone or restore his connection with the source of supply.



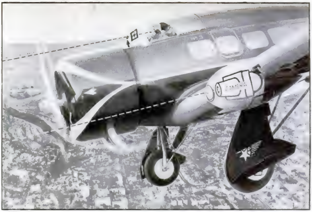
PLAYING CARDS PICTURE GOVERNMENT OFFICIALS

NEW faces for the face cards of a playing deck are proposed by a New York inventor, who holds the court cards handed down from past centuries to be inappropriate for a modern age. For the king, queen, and jack of the standard deck he would substitute three cards to be known respectively as "president," "governor," and "mayor." The new cards, he suggests, might bear pictorial likenesses of these national, state, and city officials, together with additional information such as age and birthplace, thus giving them a definite educational value.

MANCHURIAN TRAIN HAS A STREAMLINED ENGINE

LIKE western countries, Japan has turned to streamlined locomotives, and its engineers have produced the sleek steam engine pictured here. It draws a speedy train which has been placed in service in Manchuria on the 440-mile run between Dairen and Hsinking. Its schedule calls for the trip to be completed in eight and a half hours, two hours less than the time formerly required. For the comfort of passengers, cooled air will be furnished to the passenger coaches of the train.

PHOTOGRAPH PLANE IS WINGED CAMERA



Pilot aims camera by pointing the entire plane at the target, using a gun sight as view finder

A VERITABLE "flying camera" has just been completed for a Detroit, Mich., newspaper. The speedy photographic airplane flies at 300 miles an hour while the pilot aims a camera in the wing like a machine gun, by pointing the whole plane at the target. A gun sight on the pilot's windshield serves him as a view finder. When he presses a button on the control stick, the electrically-actuated camera takes 110 pictures at two-second intervals. Auxiliary cameras take photographs downward and to the rear. The machine is equipped with a mechanical pilot to allow the operator complete freedom in taking pictures. Before being placed in service, the machine will be demonstrated before War Department officials.

BOAT'S MAST REVOLVES TO ROLL UP ITS SAIL

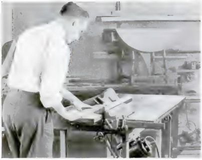
A SAILBOAT with a revolving mast is a recent creation of Fredrik Ljungstrom, Swedish engineer. The odd design is intended to make the craft easy for one person to handle, since spreading and taking in the sail are both accomplished through rotation of the mast. A special rig is used, consisting of a single double-folded sail fastened to the mast.

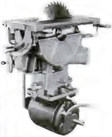
NEW BANK WINDOW FOILS HOLDUP MEN

A BANK window designed to make things hot for the holdup man has been invented by a former Army engineer. In case of an attempted robbery, the teller needs only to move his knee against a hidden trigger beneath the inner side of the window. Before the criminal could possibly make a threatening gesture, a spring actuated, bullet-proof shutter slides upward at terrific speed, effectively barricading the window and even knocking a weapon from the thug's hand if one has been thrust between the bars. Meanwhile, an ear-piercing alarm is automatically sounded.

Slight pressure on concealed trigger closes bullet-proof window and sounds burglar alarm

LIGHT BENCH SAW TILTS FOR ANGLES



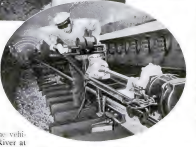


Above, portable bench saw that fits any table. Left, saw in use, tilted to cut at an angle

ADVANTAGES hitherto to be found only in heavy, stationary saws are claimed for a new portable bench saw for the home workshop, which may readily be installed in any bench or table. When angles are to be cut, the whole saw unit tilts to the required angle. The saw blade may be lowered below the working surface when it is desired to use the top of the bench for other purposes.

FREEZE QUICKSAND TO BUILD SUBWAY

Refrigerating pipes laid by subway workers in Moscow to freeze quicksand that threatened to halt all work. The solidified quicksand could then be dug out without danger



Later, in laying the tracks of the Moscow subway, high-speed electric machines like that shown below were used to fasten the rails

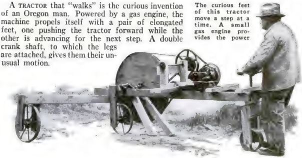
WHILE boring some of the auxiliary shafts for a new subway beneath the streets of Moscow, Russia, workmen encountered quicksand. Resourceful engineers embedded refrigerating pipes in the quicksand and froze it solid, enabling the digging to proceed. Later a concrete lining will keep out the ooze. A similar expedient was called upon some time ago in constructing the approaches for the vehicular tunnel beneath the Scheldt River at Antwerp, Belgium, as described in this magazine (P. S. M., Nov., '32, p. 24).

NEW FOUR-EDGED SQUARE AIDS MACHINIST

FASHIONED with both ends square with each of its four vertical edges, a surface-plate square just introduced by a manufacturer of precision tools makes it easy to check the trueness of machine parts, tools, fixtures, and various set-ups. Because of its unusual design and weight, the square stands firmly and cannot easily be upset. Instead of a single thin blade, it has four solid edges, all standing perfectly upright upon the surface plate. Its substantial one-piece construction also protects it from variations due to handling and temperature changes. Made of hardened steel, it is four inches high and approximately three inches between opposite edges. The photograph shows it in use.

HOMEMADE TRACTOR "WALKS" ON WHEELS

A TRACTOR that "walks" is the curious invention of an Oregon man. Powered by a gas engine, the machine propels itself with a pair of elongated feet, one pushing the tractor forward while the other is advancing for the next step. A double crank shaft, to which the legs are attached, gives them their unusual motion.



The curious feet of this tractor move a step at a time. A small gas engine provides the power

CHEMICAL WIPER MELTS SLEET ON WINDSHIELD

A special new windshield wiper to replace the regular one on sleety days. At left is the wiper with its fabric covering opened to show sleet - removing chemical within

AN EMERGENCY windshield wiper especially designed to prevent sleet from forming has just been placed on the market. Designed to be substituted for the regular one at times when the coated pane endangers driving, the new wiper contains a chemical substance that is said to dissolve ice already formed and to sweep away snow and sleet thereafter, before it can cake. The substitute wipers are inexpensive and fit any car.

MINIATURE RAILWAY CARRIES MAIL BOX

TO SAVE himself the trouble of walking half a mile from his house to the highway, the owner of a Northern Point, Ore., ranch house has constructed a miniature electric railway to deliver his mail. Its single car is a veritable mail box on wheels, which he dispatches toward the road. When it arrives at this point, a lever automatically stops it. The postman deposits mail in the car and turns on the switch, whereupon the car scoots back to the house with the letters. Dry batteries operate the power plant of the midget mail car.

The postman puts letters in the mail car and off it goes

T. F. Jardine, pilot of one of the great tri-motor planes that freighted mining machinery to the world's highest gold mine in the Andes. Right, a plane taking off from the mine site after unloading its cargo

Airplanes Help Mine Gold

Peruvian natives, descendants of the ancient Incas, unloading a heavy piece of machinery from the plane which has brought it sixty miles and across mountain ridges more than 15,000 feet high. A mule train could not make the trip by trail in thirty days

Pilot Tells Thrilling Story of Flights Over the Andes in Planes Carrying Heavy Cargoes

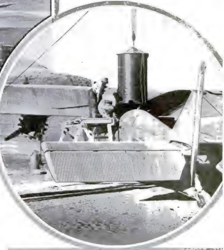
By T. F. Jardine

AMONG the crags of the upper Andes, 15,500 feet above sea level, an ancient Inca gold mine has just been equipped with modern machinery flown to the spot by plane. Seven hundred tons of steel rode on wings to the almost inaccessible site of this world's highest mine. Later on, gold planes will carry the precious bars back to civilization.

As chief Pilot for the Pan American-Grace Line in Peru, I was put in charge of the work, early last summer. Our job was to take off at Cuzco, 10,900 feet above sea level, climb through thin air over a 15,000-foot ridge of snow-covered peaks and then, with more than a ton of steel in the fuselage behind us, sit down at high speed on an improvised mountain runway.

The mine, known to the Indians as Ccochasayhuas, was producing gold before the arrival of Francisco Pizarro, the Spanish conqueror. With antiquated, hand-labor methods, it turned out a million dollars worth of yellow metal in the last two decades. In 1932, a group of Peruvian capitalists bought the mine and decided to install modern machinery. Only pack trails, winding 134 miles through mountain defiles, connected Cuzco with the spot. Mule drivers took from three to four weeks to get through and 300 pounds were the maximum they could carry in one piece. And such loads took six weeks to reach the mine. To solve their problem, the owners turned to cargo planes.

One of our all-metal, tri-motored Ford passenger planes, the *San Fernando*, was selected for the work. We first removed all the interior fittings from the cabin. Then we cut a hatch, about nine and a half feet long and four feet wide, in the top of the fuselage. All the windows, with the exception of



At left, the *San Fernando* and *San Felipe* are seen lined up on the mine's landing field beside a load of freight they have transported from Cuzco in two hours. The picture below shows workmen carefully unloading a huge cylindrical piece of equipment through the improvised hatch cut in the fuselage of the *San Fernando*

Above Clouds

two, were blocked up with sheet duralumin. On the floor of the fuselage, two rails supported a small car connected with a cable winch. Onto it, we lowered the heavy pieces of machinery, then pulled them forward to trim the ship before securing them in place.

In the meantime, 3,000 natives of the region, descendants of the Incas, were hard at work on a small plateau a few miles from the mine. Wild llamas used to feed there, hence the name of the plateau, Huanacopampa, or the llama pasture. Its elevation is 12,800 feet. As no machinery could reach the spot, picks and shovels, aided by dynamite, were employed in clearing the runway. Six months passed before the job was done. The result was a narrow strip of level ground 4,290 feet long and 330 feet wide. The runway is marked on all sides with white chalk so its boundaries are easily noted from the air. A chalk line running down the center of the strip aids in cross-wind landings. The field runs east and west and lies between two high ridges of the Andes.

In the spring of 1933, I began the aerial freighting, flying in fifty-five tons of machinery and proving the plan was practicable. The real work of heavy hauling, however, started on August 14, last. Instead of 134 miles, the pack-trail distance, we traveled, air-line, sixty miles. And, instead of nearly thirty days, required by mule travel, we covered the distance in a little more than thirty minutes.

Above is shown the hatch that transformed a passenger plane into a cargo carrier. At left, the landing field at Cuzco, from which the difficult take-offs were made

Let's follow the steps of such a flight. The start is from Cuzco, the ancient Inca capital. The airport, also used as the municipal race track, is only fifty feet wide, stretching like a narrow road for 4,400 feet. At one end, native workers under a Peruvian foreman hoist into the air heavy pieces of steel by means of a boom, gin pole and double hand winches. Then the cargo ship is rolled under the dangling load, the steel descends into the fuselage of the plane, is hauled forward, secured, and all is ready for the start.

The *San Fernando* has twin 550-horsepower supercharged Wasp engines, one on each side, and a 450-horsepower Wasp in the nose. All three are roaring at full throttle when we lumber down the narrow runway and *(Continued on page 119)*

Pearls MADE TO ORDER by Surgical Operations

1 With a surgical knife, La Place Bostwick makes an incision in the body of an abalone

2 A round piece of shell is placed in the wound as a nucleus around which the pearl grows. The wound is then washed with antiseptic

3 The "patient" is now placed in a tank of cool, clear water to convalesce. Within two months, if the mollusk lives, a pearl is formed

By ANDREW R. BOONE

BRAVING high waves, experienced hunters pried several abalones from submerged rocks along the southern California coast. Next day, with the skill of a surgeon, a "pearl scientist" operated on the abalones, placing within each a tiny, rounded piece of shell. Two months later, he again performed an operation, removing the resulting growth from each mollusk. In every case, the abalone yielded perfectly formed, unattached pearls.

For centuries man has sought to "hand grow" pearls. With a single exception, no one has found the means of producing natural pearls under controlled conditions. Yet La Place Bostwick, formerly an Iowa jeweler, not only has grown pearls in both fresh- and salt-water shells, but he also has produced several large pearls in colors.

When I visited the Scripps Institution of Oceanography at La Jolla, Calif., where Bostwick is conducting his delicate experiments with abalones, I saw several of these rare manmade pearls. A large, black pearl still attached to the "elephant-ear" in which it was grown at Muscatine, Iowa; a perfectly round, pink jewel pearl grown in an exquisitely tinted conch shell at Key West, Fla.; five white pearls still attached to a single conch shell in which they developed to maturity; eleven unattached, round, white pearls of various ages, taken from abalones; and a single attached pearl of generous size still in place against its mother-of-pearl abalone background.

Never before has man or nature, singly or together, been able to grow a pearl in two months. True, those produced by abalones in that short period have not attained final pearly luster, but all possessed roundness of form and a perfect covering over which successive layers of the pearl-forming nacre were being grown. Older specimens taken at longer intervals were hard and round and gave the appearance of natural pearls.

The abalone in which pearls are thriving is a univalve, a species of snail. In the United States it is found only along the Pacific coast. Several varieties of these exquisitely beautiful shells occur along the California shores, where I saw the hunters prying them loose from their rocky homes with the aid of leaves from automobile springs. Most of them are black, green, red, and pink. Some varieties attain a length of thirteen inches, permitting room for the growth of larger pearls than may be raised in oysters. Abalones are probably the most brilliantly beautiful shells in the world, and since pearls often take on the colors of the shell within which they grow, Bostwick hopes to add several new shades to those already produced.

As I viewed the steps taken in growing pearls, I realized that this was a task few men could perform. It requires knowledge gained by a lifetime of experimentation, the skill of a surgeon, and infinite patience.

4 The finished pearl being removed from the shell where it grew. Both attached and unattached pearls are grown

HOW an Iowa Jeweler puts live abalones to work making large, perfect pearls under controlled conditions and at record-breaking speed, is described in this article.

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Each abalone presents an individual surgical problem, depending upon its size and whether Bostwick desires to grow a free or an attached pearl. For the former, he makes a delicate incision with a sharp surgical knife, then carefully places the nucleus within the body of the live animal.

"The pearl will be formed around the foreign substance by a secretion that becomes pearly nacre, the same substance that forms the inner lining of the shell," Bostwick explained, as he subjected a fine abalone to the operation. "The foreign substance causes irritation and, as a means of self-protection, the abalone lays a film of secretion around it. In the case of a round pearl, such as this will become unless the mollusk dies, a pearl sac will grow around the intruder. The inner surface of the sac will secrete the fluid which gradually hardens and becomes a layer of pearl. As successive layers form, the pearl will increase in size and value."

Having completed the operation and sterilized the wound, Bostwick carried the "patient" from his small laboratory looking out on the Pacific ocean a hundred feet distant, into the convalescent ward, consisting of a series of square, open concrete tanks, into which sea water flows. Carefully, he slid his hand down a side wall and deposited the abalone on the bottom.

"During the first two weeks," he said, "the abalone will be rather inactive until it recovers from the effects of the incision. During this period all I can do is keep the water cool and aerated. Afterward, the mollusk will become active, crawling around the bottom and sides and eating with a healthy appetite the kelp and eel grass we kept in the tanks for food. There is little I can do to speed its recovery. There are a few mortalities during the first two weeks, but those which hurdle this difficult period usually survive and, if the nucleus has been properly placed, produce pearls.

When Bostwick desires to start an attached pearl, he varies the operation by placing the nucleus against the shell. Since the secretion forming the nacre, which consists of thin, semi-transparent films of conchiolin and calcareous matter, is more profuse near the hinge and decreases toward the thin outer edges of the shell, he inserts it nearly half the distance toward the thickened hinge. If the location is right and conditions are favorable, the pearl will grow. Sometimes increasing size causes such pressure that the pearl bursts through its covering and is released. This is one of the principal reasons why few large pearls are found.

Bostwick started his experiments several years ago at Muscatine, Iowa. Later, in his laboratory at Iowa City, he found the secret of growing large pearls in some of the 600 varieties of fresh-water shells. During that period he also discovered that he could control their color to a certain degree. He grew several black pearls in "elephant ears."

Further experiments led him to Key West. There he grew them still larger, using the great pink conch as the medium. This is a species of giant snail and a prolific producer of pearls. So prolific, in fact, that Bostwick found he could operate five times on a single conch and grow five pearls simultaneously within its shell.

"With the conch," he told me, "the secretion that hardens to form the inner lining of the shell and pearls is more profuse than with the bivalves. The structure of both shell and pearl is different. The nacreous layers are much thicker and less transparent. Conch pearls occur in pink, red, yellow, white, and an occasional rich deep brown. Most conch pearls are oval or elongated in shape and the elongated shape is caused by the extraordinary muscular activity of the mollusk. In coloring there is a tendency toward a gradual shading into white at the ends. Few round or egg-shaped pearls occur and if one is found that is of good size and quality it usually finds its way to a Prince or Rajah of India. Pink conch pearls, called 'rose perles' by the French, are the most highly prized. There is said to be a fine conch pearl from Key West in the crown of Sweden. Conch pearls of quality are little known in the United States, as they usually go to Nassau and from there to London, Paris, and the Orient."

While experimenting with conch pearls Bostwick "harvested" a round pink jewel pearl weighing forty-three grains, valued at $5,000. His successes with "hothouse" conch pearls led him to the Pacific coast and its beds of abalones, whose play of green, blue-green, fawn-yellow, and red offer an opportunity to grow pearls of rare colors. Many "pearl blisters" are now obtained, but well shaped abalone pearls are rare. Madame Nordica owned a large abalone pearl, shaped like a tear drop and weighing 176 grains. Such pearls are almost never found and are worth thousands of dollars.

Pearls differ in shape and quality according to their location in the shell or anatomy while growing. If in contact with the shell, they will become attached, and if the mollusks' organs or muscular movement interfere with the growth, the resulting pearl may assume an unusual shape. Before the secretion hardens, it is shaped by various pressures exerted upon it. It may turn out round, egg shape, barrel, button, haystack, double-header, wing, leaf, petal, lily, snail, arrowhead, or rose bud, to name a few of the recognized shapes.

Smooth, even shapes, when of fine quality, are the most valuable; but some of the curiously shaped pearls, when of good luster and beauty, are

(Continued on page 115)

A beautiful Florida conch shell with five attached pearls. Few shells will grow more than one pearl at once

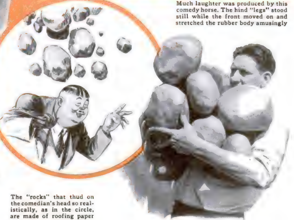
Left, a hunter prying an abalone shell from a rock exposed by the tide. They are removed with the aid of a leaf from an auto spring

The perfect gem pearl shown at right is pink in color and weighs forty-three grains. It was grown by Bostwick in a Florida Conch

Odd Machines

This dummy, made to "double" for a child actor in a comedy scene, looked very lifelike when its arms were moved by means of wires not caught by the camera

Much laughter was produced by this comedy horse. The hind "legs" stood still while the front moved on and stretched the rubber body amusingly



The "rocks" that thud on the comedian's head so realistically, as in the circle, are made of roofing paper and excelsior. E. A. Cushing, a veteran propmaker, is seen at right with a load weighing only five pounds

By JOHN E. LODGE

MOVIE studio men were stumped when a comedy script called for an oyster that would open its shell and wink one eye. But a New York maker of comedy props welcomed the job. A few days later, he appeared at the studio carrying an ingenious shell made of papier-mache. The two halves opened and closed on a spring hinge and an eye within winked when a studio man pulled a hidden string.

In another picture, a laugh-getter was a bow tie that spun around like a propeller every time an actor swallowed. A crack propmaker spent two whole days designing it. Secreted within was a coil spring. Every time the comic swallowed, his Adam's apple tripped a release lever and set the tie whirling.

From the studios of Hollywood and the East come frequent requests for such curious, absurd, fantastic bits of mechanism. They appear for a few minutes upon the screen, get their laughs and are never used again. Yet, not infrequently, it requires days of study and infinite ingenuity to produce them.

The men who supply these mechanical aids to comedy, are behind-the-scenes workers. They often work on a free-lance basis in little shops of their own. Their names rarely, if ever, appear on the screen when actors, directors, costumers, cameramen and technicians are given their due. However, their skill is vital to almost every comedy flashed upon the screen.

A few months ago, for example, the big laugh in a comedy reel came when the hero went fishing. The trout played tag around his bait and finally came to the surface and squirted water in his eyes. The comedian nonchalantly reached into a pocket, pulled out spectacles equipped with little windshield wipers and went on fishing.

That scene clicked along on the set without a hitch. But, behind it lay days of work and experiment. The spouting fish, I was told, were realistic imitations cast in rubber. Long tubes led off-stage and ended in bulbs. When these were squeezed, water squirted from the fishes' mouths. A laboratory workshop turned out the trick spectacles. These had invisible threads running down the actor's sleeves by means of which he operated the midget wipers.

Of comedy propmakers, the New York firm of Messmore and Damon is probably the most famous. With machine shops, papier-mache rooms, carving benches and 27,000 square feet of floor space, it turns out a weird list of products ranging from rubber asparagus to mechanized prehistoric monsters; from sixteen-foot saxophones to animated cupids that shoot arrows; from a winking statue of George Washington to a black stork to deliver a Negro baby!

This concern has made so many comedy props that it can quote prices over the telephone for almost any fantastic mechanism you can think of. A balsa-wood alarm clock, a mechanical spider and a whirling necktie, for example, would together cost you in the neighborhood of a hundred dollars.

On the day I visited the plant, workmen were putting slide fasteners in the hind legs of a horse. The imitation animal was to double for a real horse in a comedy. Two actors in the legs were to go into a comic dance and the slide fasteners would

Put Fun *in* Movies

enable them to get in and out. The body was formed of papier-mache and the legs of a special fabric. Viewed from across the room, the real horse and the imitation animal could hardly be told apart.

A few days before, finishing touches had been put upon a nine-foot camel. Slide fasteners in the humps enabled comedy characters to use them for luggage carriers on a burlesque trip across the Sahara. Another ludicrous prop was a horse with rubber-fabric sides. During the action of the comedy, two actors inside the horse were supposed to become mixed up in their signals. The rear legs stood still while the front legs kept on going until the horse was stretched to three times its normal size.

Such orders are all in the day's work for the propmaker. Requests for trick fountain pens that pour out ink when the point is pressed against paper, for rubber stirrup straps that stretch and then fly back when a comic starts to mount a horse, and for trunks that are designed so they fall apart when a string is pulled, are comparatively easy ones.

An expanding turkey which was ordered last year, however, was not so simple. It was made of special rubberized fabric and contained a heavy rubber balloon. In the comedy in which it was used, bushels of dressing were stuffed into the turkey, the dressing being shoved down through a hole in the table while the balloon expanded farther and farther until the bird was the size of an ostrich. When a knife was stuck into the bird at the Thanksgiving dinner, it collapsed to the size of a robin.

CROCKERY MADE TO BE BROKEN

The pitcher at the right was made by coating the inside of the mold with plaster of Paris. Taken from the mold and given a coat of paint, it looks heavy, and makes a realistic crash when shattered before the microphone. Wax objects do not register well

A fragile chair weighing one pound, and a stalk of the yucca, from which it was made

STRANGE DEVICES USED TO MAKE SOUND EFFECTS MORE REALISTIC

The antics of two comedians when cartridges exploded in a camp fire made a funny scene, but the sound that the audience heard was made by exploding firecrackers in a garbage can, as is shown in the photograph above

This comedy taxicab was covered with queer gadgets and accessories designed to bring laughs from movie fans

Another puzzler for a Hollywood prop designer was a breathing cake for a Hal Roach "Our Gang" comedy. Five children had gathered around a birthday-party table when the huge frosted cake in the center began to breathe, expanding and contracting while the guests' eyes popped out in amazement. The cake was covered with rubberized fabric over which the frosting was placed. A battery of small balloons encircled the cake beneath the outer covering. Off-stage, workmen pumped air in and out of the balloons, producing the appearance of breathing.

The other day, a comedian on a Hollywood set reached for a broom, intending to frighten his co-star with a playful tap on the head. Instead, his hand grasped a sledge hammer. Swinging it in a great arc, he crashed it down on the skull of the other actor. The blow was so hard that it broke the hammer. However, the complete tool weighed only three ounces and the head and handle, both made of desert yucca, were stuck together with two toothpicks and a little mucilage.

Every fall, Hollywood prop men scour the desert foothills of Southern California, fighting rattlesnakes in their search for yucca *(Continued on page 114)*

Small-Bore

ENLISTS ARMY

By
ROBERT
E.
MARTIN

A basement rifleman shooting at an ingenious target on which tiny glass ducks are swung around by a rotor propelled by wind from an electric fan. The arrangement of the target is shown at right

NOT long ago, there descended upon a few hundred acres of Northern Ohio soil a big army armed with little guns. The small-bore marksmen of the country were congregating for their grandest event of the year, the National small-bore matches, open only to persons who find excitement and fun in shooting .22-caliber rifles.

Although this national match, which takes place every summer at Camp Perry, provides a cross-sectional view of one of the most popular sports in America, its week of crowded activities is only a drop in the bucket when compared with the total of small-bore activity. In every town and hamlet from the Southwest to the heart of New York City, you can hear the crack of the little "twenty-two." It casts its magic spell over small boys and tottering granddads alike.

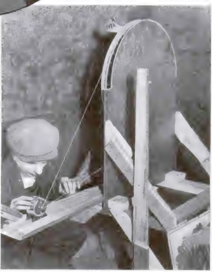
That shooting is a leading hobby is indicated by figures prepared by the National Rifle Association, which governs recreational shooting activities and acts as a sort of clearing house for information on the sport. There are, according to the estimates, at least 100,000 junior shooters who burn up powder more or less regularly, boys in their teens for the most part—and girls, too. Then there are some 250,000 grown-ups who are known to be active in rifle shooting. In all, there probably are more than a half million persons in the United States who are capable of hitting something when they shoot at it. Some are expert shots, others are just shots, and the great majority are probably more skilled in the art of shooting than many a military man.

Although this sizable army of shooters is strictly a bunch of hobbyists who go in for guns and bullets as enthusiastically as other people follow amateur photography or stamp collecting, it is providing, as a sort of by-product, an important reserve force that would be valuable in event of war. Doubtless, too, many a highwayman has had his career terminated suddenly because some bank clerk or gasoline-station operator was an amateur shooter. Congress has recognized the importance of amateur shooting, and has done much to encourage it. Unfortunately, the depression has made necessary a curtailment of this encouragement in recent years.

Most of the firearms used by amateurs are of .22-caliber size. Perhaps the chief reason is that guns and ammunition of this caliber are not expensive. A fairly accurate "twenty-two" can be purchased for less than five dollars, although you can pay several hundred dollars for a gun of the same caliber, if you want to do so. The .22 long-rifle cartridge, the size used for most serious small-bore shooting, is accurate enough to satisfy the most exacting; yet it is small enough to permit its being used indoors in the average basement, without disturbing the entire neighborhood.

You will find the typical rifle club or other collection of shooters to be a diversified crowd. Here, for instance, is a marksman whose idea of Heaven is a place where he can lie forever on his stomach and put one bullet after another into a little black circle in the center of a square of cardboard a hundred yards away. He is the typical target shooter, the type that probably leads in point of numbers.

But there are thousands of riflemen who care little or nothing about straight target shooting. They demand something more exciting, something with



Another mechanical target, with a glass deer mounted on a bicycle wheel which is turned by a small electric motor. A piece of boiler plate protects the wheel from stray shots

Shooting Hobby

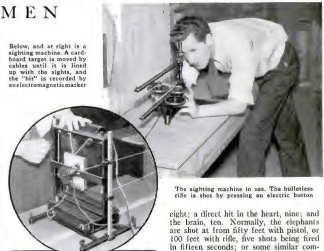
OF MARKSMEN

more action in it. Among them we find the crow and woodchuck hunters, tin-can marksmen and the like.

And then there are some gun fans who seldom shoot at all. They frequently have a large-sized arsenal, but a surprisingly small supply of ammunition. In this group are the collectors of firearms, and the amateur craftsmen who construct special stocks, or even make entire guns that rival commercial products. In fact, many active riflemen find pleasure in constructing their own gun stocks and making other alterations that fit their firearms more closely to their personal tastes and needs.

One of the simplest, yet most interesting of outdoor targets consists of nothing but a brightly colored disk of wood measuring about one-fourth by one and one-fourth inches, and equipped with a metal pin so that it can be fastened to a tree, fence, post or other support. The disk resembles a checker piece, and breaks when it is struck by a bullet. These inexpensive disks have become so popular for "plinking" targets that they are sold by the thousands.

Another novel shooting sport makes use of an elephant target. This is a picture of a running elephant that is divided into blocks of various shapes. Each division is assigned a definite value. A hit in a tusk, ear, tail, lip, or trunk counts nothing, these being the least vital spots. A hit in the head or flank counts three; in three body areas, four, four, and five, respectively; near the heart, six; near the brain, seven; in any leg, seven; the backbone, eight; a direct hit in the heart, nine; and the brain, ten. Normally, the elephants are shot at from fifty feet with pistol, or 100 feet with rifle, five shots being fired in fifteen seconds; or some similar combination can be employed. In all, the elephant target provides something different for shooters. It measures twelve by eighteen inches, and is printed on heavy cardboard.



Below, and at right is a sighting machine. A cardboard target is moved by cables until it is lined up with the sights, and the "hit" is recorded by an electromagnetic marker

The sighting machine in use. The bulletless rifle is shot by pressing an electric button

At right, the trigger of a rifle is being "weighed" to determine the pressure required to fire it in actual target work

A weighted pipe being used to steady a light pistol by absorbing small vibrations

This idea of using printed images of game animals as targets has been developed into a series of colored paper targets on which the animals are depicted life size. Some pictures have a superimposed bullseye, with the center over the most vital spot. Most of the animals and birds are pictured in a running or flying position, so that the targets can be mounted on light cardboard or cloth stretched over a frame, and equipped with a cable-and-pulley mechanism to move them across the field while the shooter bangs away. By using colored paper stickers to cover up bullet holes, the life of such a target can be prolonged indefinitely. Among paper targets available are those showing a running deer, elk, and rabbit; standing rabbit; flying pheasant, duck, hawk and quail; standing deer; sitting hawk; and running pheasant, fox, and small deer.

Mechanical targets have become popular with small-bore shooters on both outdoor and indoor ranges. One type of target consists of a metal box with five projecting bull's-eyes. When any of the four outer bull's-eyes are struck, they drop out of sight. A hit on the smaller center bull causes the four others to reappear. Another target working in a similar way has a center bull's-eye flanked by two "dodo" heads. When the heads have been knocked out of sight, a shot on the bull's-eye brings them into view again. Such targets are also suitable for use with the more powerful air rifles.

An inventor recently perfected a sighting device that provides shooting experience without the necessity of firing a cartridge. The shooter reverses the usual process and moves the target instead of the gun. The target consists of a cardboard sheet with a bull's-eye printed on one side. This is attached to a pair of cords which can be moved by operating control wheels attached to the gun rest. The rifle or pistol is held securely by the rest.

The shooter sights along the barrel, and by means of the cords moves the target until it is apparently in position for a bull's-eye hit. Then he presses an electric button, which causes an electromagnetic device to force a pencil against the back of the target, making a dot at the point at which a bullet would have hit if one had been fired. Before the "firing" is started, the gun is sighted accurately on the spot at which the mark is made. The inventor believes that his device will be of value to police departments, rifle clubs and other groups desiring shooting practice without the shooting.

Shooters who are fond of card playing have been provided with a target designed for "poker shooting." This is a printed layout of playing cards, with two jokers and two "M" cards that count as misses. Draw or stud poker can be played. Frank P. Carey, inventor of the target, has suggested that any betting involved be done with .22-caliber cartridges instead of money. One poker target is good for at least fifty shots from a .22-caliber pistol or rifle.

The building of small indoor ranges, in basements usually, is becoming a popular activity among shooters. Such ranges are easily set up, when space is available and a suitable back stop can be arranged for keeping bullets within bounds. Heavy timbers or sheets of boiler plate set at proper angles to prevent dangerous ricochets can be used. Another way of stopping bullets is to use a metal funnel device manufactured for the purpose. This apparatus catches the bullet, allows it to spin around a while until its energy is spent, and then drops it into a container from which the accumulation can be removed for melting, to recover the lead.

When conditions are unfavorable for regular small-bore firearms, excellent shooting can be done with one of the high-powered air rifles or pistols available. These guns use compressed air charges instead of powder, for propelling specially shaped lead slugs, steel or lead balls, or feathered darts. They are remarkably accurate, particularly over short ranges; and most of them shoot hard enough to kill rodents and other small game.

The holding of novel competitions is becoming a common practice of gun clubs. In addition to straight target shooting, all kinds of freak target games are employed to arouse interest of visitors. Such events are really shooting carnivals, with visitors paying so much for the privilege of shooting. In addition to raising money for club activities, these gun carnivals usually attract many prospective members who may join.


A mechanical tiger target operated by an old washing machine motor. The object is to shoot out the small glass disk seen in the man's hand. This represents a vital spot in the animal

Inventive genius apparently knows no bounds when it comes to working out unusual ways of using up powder and lead. The Zeppelin Rifle Club of Akron, Ohio, for instance, staged a shooting carnival that included elephant hunts, tiger hunts, and other big-game activities. Tiny glass elephants normally intended for use as watch charms were employed as targets in some of the shooting games. Electric motors, old washing machines and other odds and ends were used for operating moving targets.

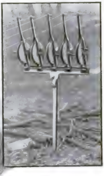
But in spite of the many byways of shooting, the very foundation of the small-bore sport in America is straight target competition.

While much shooting is done in basements and fields by persons who care little or nothing about competitive matches, the rifle club provides for others the opportunity to match their skill against rival gun artists. Competitive small-bore shooting is done generally at ranges of fifty, 100 and 200 yards, and at fifty meters. The fifty-meter range was used officially for the first time in 1934. In addition, there are rifle targets available for ranges as short as fifteen yards, and pistol targets for ranges from twenty-five feet up.

One of the most interesting .22-caliber competitions is the Dewar match, the American part of which is shot at the annual Camp Perry small-bore meet. The competition is between an American team of twenty shooters and an English team of the same size. Scores of each team are sent by mail to the other country. In the 1934 match, the English team completed its shooting first, and one of its members made a perfect score of 400. Not to be outdone, Sam Bond of the American team hung up a similar perfect score at Camp Perry later in the season.

A noteworthy fact about target shooting is that instances of accidental injury on properly constructed and supervised ranges are extremely rare. The man or woman who is familiar with firearms and who finds pleasure in shooting them has, in almost every case, developed a proper respect for their power and a love for them as a hobby tool. That is the attitude of the typical shooting hobbyist, and it leaves no question as to the wisdom of encouraging the inborn and thoroughly American liking for firearms, inherited from a proud ancestry of pioneers and frontiersmen for whom the squirrel rifle was both a weapon of defense and a means of obtaining food.

The growth of cities and the increase in urban life with its sedentary occupations have tended to reduce the opportunities of the American to indulge his enthusiasm for the rifle and the moving target. Promotion of rifle matches everywhere now is enabling him to shoot.


Left, targets used in the new game of Gofort, which combines the thrills of target and game shooting. Targets are mounted on the reels shown above, and exposed by pulling the various cables

Worn-Out Auto Tires

REBUILT BY NEW PROCESS

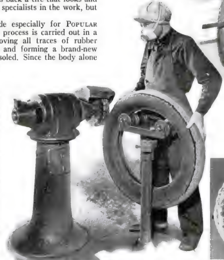
NEW tires for old are offered today's motorist. Instead of discarding a casing worn out by twenty thousand miles or so of service, he may have it "rebuilt" by modern scientific methods. He gets back a tire that looks and wears like a new one, according to specialists in the work, but costs only half as much.

Photographs on this page, made especially for POPULAR SCIENCE MONTHLY, show how the process is carried out in a typical shop. It consists of removing all traces of rubber adhering to the body of the tire and forming a brand-new tread upon it, much as a shoe is resoled. Since the body alone represents sixty percent of the cost of a new tire, an appreciable saving results.

Recent developments in motoring have helped spread the new fashion of rebuilding tires, and multiplied the number of shops specializing in it. The body of a modern tire, expert rebuilders point out, is far stronger and more resilient than that of former types. Concrete roads spare it the bruising blows of rocks, ruts, and road bumps. Hence, it may still be good for long service when the rubber tread, worn down by the powerful braking and quick starts of present-day cars, is almost gone. A careful examination is always given to make sure the body is intact, for rebuilding is feasible only when it is free from breaks and signs of weakness.

OLD RUBBER COMES OFF

1 The first step in rebuilding a worn-out tire. With a long, sharp knife made of file steel, a workman pares off the old rubber in strips, going as close to the cord as he can with safety



2 Rubber is buffed off the shoulders with a tack-studded band, and the cushion under the tread is ground off with a steel brush. The photo at right shows the band and brush

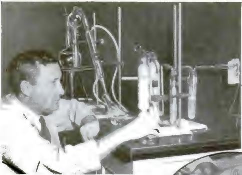
NEW TREAD STOCK APPLIED TO CORD

3 The body of the tire is given two coats of rubber cement, as shown in the small picture. Then raw tread stock like that used in new tires is applied to cover the top and sides

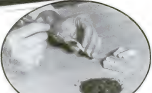
NEW RUBBER BONDED ON BY VULCANIZING

4 As the final process, the new tread is vulcanized to the body in a steam-jacketed curing mold. The new rubber fills the spaces between the cords and forms a perfect bond. The tire is now ready for use

ROBOT SMOKER AIDS CIGARETTE STUDY



Left, robot smoker puffs a cigarette and separates the smoke into its component parts for a study of nicotine and stain removal



In oval, preparing experimental models of filters to take objectionable substances from cigarette smoke

A MEANS of divesting cigarette smoke of fifty to seventy-five percent of its nicotine, and most of the tarry distillate that causes stains, is the reported discovery of Prof. F. Almy, Ohio State University chemist. It may be incorporated in a diminutive device that is built into a cigarette holder or inserted directly in a cork-tipped cigarette. The device draws the smoke through a cotton pad and a chamber filled with granules of activated carbon. The first removes the tarry substances; the second, the nicotine. Tests with a robot smoker, that automatically smokes a cigarette and analyzes its smoke, led to the choice of the materials employed.

SNOWSHEDS JOIN LONELY MOUNTAIN POWER HOUSES

SNOWSHEDS have found a new use in the mountains of California, where they enable workers of a great hydroelectric plant to travel to and from their homes, and to get from one power house to another. Since it is not uncommon for snow to be piled ten feet deep after a severe storm, the snowsheds often afford the only means of getting about for those without snowshoes. The sheds resemble those used to keep railroad tracks clear.

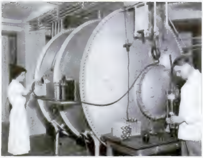
NEW DRINK DISPENSER FOR AUTOS

Drink container for automobiles, showing how cup is detached

WITH a new drink dispenser attached to the paneling of his car, a motorist may now slake his thirst while driving. The container, held in place by a spring clip, has a cup attached to its lower end. To get a drink, the motorist presses a plunger in the side of the container and releases the cup by giving it a partial turn. The container is heavily insulated so that cold liquids placed in it are kept cold, and hot liquids are kept hot, for long periods of time.

TESTS SHOW THAT GERMS FLOAT IN AIR

BY SPRAYING germs into a huge metal tank lined with glass, William F. Welk, Harvard School of Public Health sanitation instructor, is learning new facts about the spread of disease. Contrary to prevailing medical belief, his tests are reported to indicate that minute droplets of moisture expelled in the act of coughing or sneezing do not settle rapidly to the floor but float in the air, with any germs they may contain, for a considerable period. The germs, moreover, do not die quickly but may live for hours. The tests may affect air-conditioning plant design.



Samples of air being withdrawn from tank for germ test

From this complicated switchboard behind the scenes, hands and plays of expert bridge players are flashed before the spectators

ELECTRIC BOARD REPRODUCES BRIDGE GAME

Below, giant electric switchboard that shows progress of bridge game

RAPID-FIRE work at a battery of switches connected with a giant electrical board, recently introduced at Chicago, enables an auditorium filled with bridge fans to follow every play in a game between crack players. Standing behind the contestants, an announcer speaks rapidly into a telephone receiver, relaying information to an expert at the switchboard, who throws the proper switches to flash upon the board illuminated letters and symbols which show the cards held by each player, as well as the bids and plays made.

Flying Whirligig Is Newest Aircraft

Here's how new air monster may look in flight, using both windmill vanes and fixed main wing

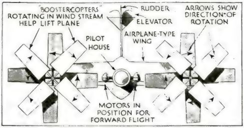


Diagram shows how revolving vanes, set near each wing tip, add lifting power and enable craft to alight within very small space

A "FLYING WHIRLIGIG" combining the principles of the standard airplane, the autogiro, and the helicopter, is envisioned by a Glenn Dale, Md., inventor, just granted a patent. His design calls for a main wing of conventional form, having at each extremity a set of windmill-like vanes, or "boostercopters," arranged to rotate freely when the craft is in motion; their lift aids the main wing to support the machine. The two rotors of each set revolve in opposite directions. Twin propellers, flanking an elevated "pilot house," constitute its power plant. They swing upward to provide additional lifting force during the take-off, and return to horizontal position for forward flight. The inventor foresees the construction of huge air liners which could leave the ground or alight in congested areas where space is limited.

MAPS EARTH'S MAGNETISM

A CURIOUS pattern of loops adorns a geographical globe recently exhibited by A. G. McNish, of the Carnegie Institution's Department of Terrestrial Magnetism. Lines depict the earth's magnetic field, and center about the magnetic poles. The model illustrates the behavior of the earth as a big magnet, and demonstrates the daily variations of magnetic force.

RUBBERS FIT IN UMBRELLA

COMPLETELY equipped for rain is the user of a two-in-one umbrella containing a pair of rubbers within its handle. Tightly rolled to occupy little space, they are withdrawn in a jiffy as shown above. When the handle is in place, as below, the umbrella appears to be an ordinary umbrella, in every way.

FIRES SET IN ODD SAFETY TEST

SPECTACULAR tests recently were made by a Maryland power company to learn how best to combat fires in its huge, oil-filled transformers. Engineers constructed an outdoor enclosure for the trials, set up a standard transformer, and repeatedly set it aflame. From the sidewalls, streams of water and of chemicals were spilled upon the blaze. As a result of the tests, an effective design has been worked out for fire-fighting equipment that has now been installed to guard against damage.

Power-plant engineers watch apparatus they designed subdue transformer fire purposely set in safe outdoor laboratory

SAFETY PHONE GUARDS AGAINST EXPLOSIONS

A NEW type of explosion-proof telephone, exhibited in Chicago, is a recent addition to the roster of curious safety appliances developed especially for use in industries where dust, gunpowder, or inflammable gases present the constant hazard of a blast. Not only does the construction of the instrument guard against the possibility of an electrical spark igniting any combustible material in the surrounding air, but even the mechanical working parts have been designed particularly with a view to reducing friction so that a spark cannot be produced.

TREES MAY FORECAST WATER SUPPLY

TREE rings help Harry L. Potts, Denver, Colo., water department engineer, to estimate the future water needs of the city. Wet or dry years are recorded in the varying width of the annual growth rings of trees. He is charting the yearly rainfall for the past 500 years in the area supplying Denver. The finished charts, he expects, will show how much water must be stored to meet any emergency, and may also throw light on whether droughts occur in cycles that can be forecast.

Engineer graphs droughts and rainy spells from tree's growth rings

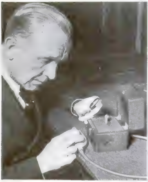
New sanding drum which expands to hold sleeve

IMPROVED SANDING DRUM

SANDING drums, which save the time and effort of sandpapering woodwork by hand, are now available in improved form. One new type employs an especially ingenious method of attaching the abrasive sleeve. The drum itself is of molded rubber, which may be expanded by tightening a spindle nut. This firmly grips the encircling belt of abrasive material, making a snug fit and providing a desirable resilient backing.

TINY ENGINE FITS FLASH-LIGHT BULB

A MINIATURE engine so tiny that a magnifying lens is needed to watch it run has just been completed by Lieut.-Commander John W. Iseman, U.S.N.R., after six months of spare-time work. The model, according to his information, is about half the size of the world's previous smallest, which is housed in a museum at Munich, Germany. Patterned after a conventional stationary steam engine, his model, Iseman says, has working parts more delicate than those of the finest Swiss watch. When compressed air is fed to the model by squeezing a rubber bulb, a 0.03-inch piston races up and down in its cylinder, and a 0.2-inch flywheel spins with a faintly audibly whirring sound at speeds up to 3,000 revolutions a minute. The amazing model was constructed beneath a microscope, with the aid of an especially designed precision appliance known as a Geneva lathe. Iseman made some of the smallest parts, including the crank pin and crank shaft, of beryllium metal, because of the difficulty of machining steel to almost infinitesimal dimensions. He drew the intake pipe, of platinum, through a sapphire die to reduce its inside and outside diameter, thus obtaining a tube that makes a common pin look like a tenpenny nail by comparison. Cylinder and valve ports, had to be made with a precision of half a thousandth of an inch. A flash-light bulb provided a protecting glass case for the completed model.



Builder of fly-size engine watches through magnifying glass while squeezing bulb for power. Right, engine compared with a pin head, showing how incredibly small it is

PROFESSIONAL TASTER CHECKS SOAP MIXTURES

FEW might envy Joseph Strobl, of Los Angeles, Calif., his strange profession of tasting soap. By sampling the contents of the huge caldrons in which the product is made, as above, he can tell whether the mixtures have been sufficiently "cooked" and are done. Despite its apparent crudity, this test is said to show the amount of free alkalinity in the soap with high precision, revealing in a moment what would otherwise require three to four hours' laboratory work. The value of this time-saving is shown by the fact that Strobl tastes seventy samples every day.

Home-Work

By **BERTON BRALEY**

THOUGH our residence is furnished
With the best I can afford,
Old mahogany well-burnished,
Antiques skillfully restored,
Cabinets that craftsmen fashioned
For a Ghibbeline or Guelph,
—Yet my hobby most impassioned
Is for things I make myself!

Yes, there's something of a wobble
To the tables that I cobble,
And the chairs I manufacture
Are susceptible to fracture
And my cupboards lack in symmetry and tone,
Yet the worst of my creations
Brings me prideful titillations
As I murmur "It's a poor thing, but my own!"

We've electric fans and heaters
Gadgets intricate and new,
Onion-peelers, omelette-beaters
And I love to run 'em, too;
Constantly the salesmen bring us
Household tools—and take our "pelf,"
—But my real kick is a dingus
That I've fashioned for myself.

Something wrangled out of wire
And an ancient auto-tire,
Some mechanical appliance
Which defies the laws of science
But which I have planned and figured out alone,
Though it creak and squeak and rumble,
If it *works*, I'm far from humble
As I murmur, "It's a poor thing, but my own!"

Artisans and artists skillful
Think me just a trifle daft,
But my life's not truly thrillful
Till I try *my* handicraft,
Till I saw and plane and hammer,
Build a dog-house, paint a shelf,
And get rich, authentic glamour
Out of things I make myself!

CARVE HUGE EYE FOR MOUNTAIN MEMORIAL

WITH the face of Washington already looming from the giant memorial that Gutzon Borglum, famous sculptor, is carving from the living rock of Mount Rushmore, S. D., artisans are now at work on the likeness of Thomas Jefferson that will stand beside it. Photographs reproduced here illustrate one of the most interesting operations—the carving of an eye, whose size is appreciated by comparison with the man alongside in the picture. The design, curious when viewed at close range, appears startlingly lifelike when seen from the base of the towering peak.

Size of sculptured eye shown by figure of man

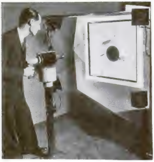
Workmen outlining the colossal eye of Thomas Jefferson. Note drill holes

Trainman taking orders from new device

MOVING TRAIN PICKS UP ORDERS

TRAIN orders, like mail, may be picked up by a moving train with the aid of a device produced by a Missouri inventor, consisting of a post set beside the track and bearing three detachable hoops. Orders are attached to the hoops, which are so mounted that a slight pull frees them. Thus the engineer or fireman may grasp a hoop without moving from his place in the cab. The two upper ones are for the first and second engines of a "double header," while the lower one is for the conductor's orders and is at the proper height for the step of a caboose.

Mystery Gun Shoots Spot of Darkness



Aiming the gun moves the black spot on screen

TO ATTRACT customers to their toy sections, department stores have recently exhibited an ingenious illusion representing an imaginary war weapon of the future—a gun projecting an "invisibility ray" of inky darkness, in order to hide, as with a smoke screen, a rocket ship on which it is trained. A spectator may grasp the "gun" himself and train it upon a painted screen, producing a black spot that appears to come from the gun itself and to follow its movements. The secret of the mysterious effect lies in perfect synchronization between the "gun" and a projector hidden behind the translucent screen, which is accomplished through concealed cables as explained in the accompanying diagram. All controls pass downward through a small tube, horizontally beneath the floor, and upward through another small tube. Two lamps are controlled from the gun trigger through wiring not shown in the diagram. One illuminates the entire screen while the other illuminates all but the spot itself, the change being made automatically as the trigger is pulled.

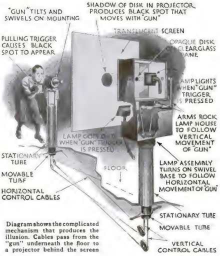


Diagram shows the complicated mechanism that produces the illusion. Cables pass from the "gun" underneath the floor to a projector behind the screen

SAWS AND PAINTS WITH ONE MACHINE

WITH a curious power-driven machine of his own design, a California man can saw wood and then, after a slight change, paint with the same device. The outfit comprises a small gasoline engine, a circular saw, and an air-compressor. Mounted in a stand over the compressor, the saw is driven by a belt from the flywheel pulley of the gasoline engine. By disengaging this belt and slipping another over the drive pulley, the compressor can be used to operate a paint spray gun. The device can easily be towed from job to job. Its inventor, a telephone repair man, used it to add to his income from small contract jobs near his home.

CAMERA SNAPS HARDEST GLIDER STUNT

WHILE Wolf Hirth, German sailplane expert, looped the loop in a glider, a photographer in an accompanying plane snapped the striking picture reproduced here. Since the glider pilot has no motive power on which to rely, his stunting performances depend upon his ability to guide his frail craft into favorable wind currents and to avoid losing too much altitude during the maneuver.

Unusual photograph of difficult feat of looping the loop in a glider

NEW KIT HELPS MATCH COLORS WITH LACQUER

MATCHING colors with lacquer, in painting furniture or an automobile body, is made easy by a kit recently introduced. It consist of a set of eight cadmium-plated measuring cups ranging from one sixteenth of a fluid ounce to eight ounces, and a stand for storing and using them, with places for paint strainers, color sheets, and formulas, and a drawer for a paint paddle and a brush to clean the cups.

BIKE GETS SPEEDOMETER

SPEEDOMETERS for bicycles are on the market, permitting a youngster to enjoy the thrill of seeing just how fast he is going. In the model illustrated, the needle is actuated by a friction drive on the front wheel. The dial is attached to the frame behind the handlebars, and reads, perhaps a trifle optimistically, from zero to fifty miles an hour.

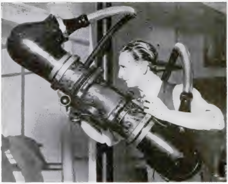
Speedometer operated by wheel of bicycle

NEW DEVICE MEASURES THE MOISTURE IN FOG

CONTINUING their experiments with artificial means of dispelling fog, Henry G. Houghton and fellow scientists of the Massachusetts Institute of Technology have devised an auxiliary instrument that might be termed a "fog meter." The curious device, shown above, measures the water contained in the fog. At the top of the picture may be seen a part of the hanging pipes that spouted a chemical spray in recent successful attempts to combat fog, a path of clear air 2,000 feet long and 100 feet wide being produced by this means. (P. S. M., Oct., '34, p. 39).

X-RAY TUBE LOOKS LIKE A BASSOON

SHAPED like a giant musical instrument, the curious apparatus shown at the right is actually one of the most modern types of X-ray tubes. Operating on 250,000 volts, it produces powerful and penetrating rays for deep therapy treatments. Heavily insulated cables provide the power supply and the instrument is declared to be completely shockproof. It was recently placed on public view in London.



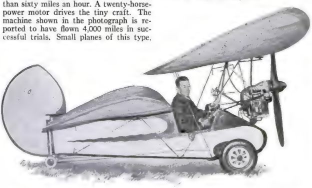
Odd view of latest-type X-ray tube now used for deep therapy treatments

CLEANER STAYS IN PIPE TO ABSORB NICOTINE

An ordinary pipe cleaner, kept inside a smoking pipe of new design, serves to absorb moisture and aids in keeping the smoke sweet and clean. The smoke is drawn through an aluminum tube with a slit bottom, through which droplets of moisture seep into a lower chamber containing the pipe cleaner. The cleaner may be removed and replaced, as shown above.

MIDGET PLANE DOES A MILE A MINUTE

DUBBED the "sky flea," a midget airplane just introduced in France measures less than twenty feet between wingtips. It is said to take off with a run of only 100 yards, and to fly at a speed of more than sixty miles an hour. A twenty-horsepower motor drives the tiny craft. The machine shown in the photograph is reported to have flown 4,000 miles in successful trials. Small planes of this type, because of their low cost, economy of operation, and versatility, are expected to give a great impetus to aviation as a sport. They can be housed almost anywhere, and need no large landing field.



"Sky flea" plane recently introduced in France. It has a wing spread of less than twenty feet

"ROPE TRICK" PICTURED IN CLEVER CAMERA HOAX

HAS the famous Indian rope trick actually been performed? A photograph just received from England, and reproduced here, apparently shows a *fakir* in the very act of executing the feat. According to legend, the trick consists of throwing a rope into the air and causing it to become rigid so that a boy can climb it and disappear. Skeptics examining the arresting picture, however, will suspect that what masquerades as a rope is actually a rigid iron shaft, upon which the boy balanced himself long enough for a cameraman to snap the picture. Professional magicians challenge anyone to perform the trick.

At left, beet toppers are seen at work in a Colorado field. Above, a worker displays the finished product and the raw material. One good bushel of beets will make the ten pounds of sugar in the sack

MARVELS OF CHEMISTRY BRING TO YOUR TABLE SUGAR

By Frank Clay Cross

SUGAR beets—fifty million of them! There were enough of the big, white, conical roots in the mountainous pile in front of me, to lay in a double line from New York City to San Francisco; enough of them to sink the largest ocean freighter ever built. Forty thousand tons of them! A quarter of a million dollars' worth of sugar beets!

Beyond the beet mountain, housed in a structure as big as the hangar for a giant Zeppelin, another mountain was rising—a mountain of sugar, stowed in sacks. Day and night a river of beets was flowing down from the one mountain into the big sugar factory at Brighton, Colo. Day and night, a river of sugar was flowing out of the factory, building the mountain in the great storehouse. In a few weeks the beet mountain would be gone, and the sugar mountain would fill the storehouse to the very roof.

Of all the foods and delicacies that reach our tables, probably none has gone through such complex processes of manufacture as the little white crystals in our sugar bowls. To follow a truck-load of beets from the time when they are plowed from the ground, until the sugar in them is extracted to flow in a snow-white avalanche into the sacks that await it, is to witness one of the most spectacular operations in modern food production.

The beet seed is planted early in the spring, as soon as the ground is warm enough to cause germination. Like wheat and other small grains, it is drilled in rows about twenty inches apart. A few weeks later the fields are ribboned by thick stands of little plants. Now come the blockers and the thinners. A veritable army of thousands of men and women invade the fields on hands and knees. These are the thinners. Ahead of them goes a smaller army of blockers, hoes in hand, who chop out regular intervals in the stand, leaving small bunches of plants every ten or twelve inches along each row. The thinners complete the job, pulling up every plant save one in each bunch left by the blockers.

The task of the thinners is one of the most tedious and back-breaking drudgeries known to agriculture. Most of the workers are Mexicans. You see them moving slowly down long rows of beets, some stooping, some crawling on all fours, hardly pausing as they work, hour after hour, under the hot sun.

When the fields have been thinned, they are cultivated and irrigated at intervals until the beets are ready for harvesting. They are then plowed from the ground, topped, and loaded directly into the trucks that carry them either to the factory or to the beet dumps from which they are transported to the factory by rail. For many years, inventors have sought to design some machine which would automatically cut the top off each beet as it is plowed from the ground, but thus far no satisfactory way has been found to replace the human toppers who do the job by hand with heavy, sharp knives.

I stood beside the great beet mountain at Brighton, watching the long file of trucks as they passed over the scales to be weighed, and thence to the mechanical unloader. As each truck came alongside the unloader, the truck box was tilted to slide a torrent of beets into a big hopper, from which they were quickly elevated fourteen feet to the top of the beet pile. It was awe-inspiring to realize that every beet in that endless stream had been thinned and topped individually by human hands. If it were possible for me to count the beets in that beet mountain, at the rate of one per second, pursuing my count continuously for eight hours every day and seven days every week, there would still be beets uncounted at the end of four whole years. Yet that pile was only one of many in the West. There were sixteen other sugar factories in Colorado alone, every one with a beet mountain beside it, and many other piles were scattered through the sugar-beet country, away from the factories.

Under the mountain in front of me were numerous channels, filled with swift currents of water and so designed that they could be uncovered, section by section, to allow the beets to course down into them. The water carried them, bobbing and tumbling like logs in a mill stream, into a trash house where the heavier debris was churned and snagged out of the flood. Then they were caught up by an elevator and lifted to the washer on the top floor of the factory.

"We'll follow them right through the plant," my guide said. So up we went to watch the beets roll out of the washer. They were as clean, when they came forth, as if each had been scrubbed by a fussy housewife. That was not enough, however, for as they moved toward the slicers,

A mountain of beets destined to be transformed into white sugar

from Beets

Workers filling a cell in the diffusion battery with beet cossettes, or shredded beets, to extract the juice by osmosis

they passed under the watchful eyes of a worker whose hand flashed among them, now and then, to remove imperfect beets and occasional pieces of debris that had escaped the mechanical cleansers.

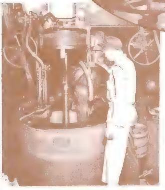
"One grab by that man may save several hundreds of dollars," my guide told me. "If a piece of wood, or a stone, gets into the slicers, the whole factory may have to stop work until repairs are made."

The slicers are cylinders lined with knives which reminded me of the vegetable shredders to be found in nearly any kitchen. When the beets emerged from them, they looked much like Chinese noodles. Indeed they are commonly called noodles, though the proper name for them is cossettes.

We could look down, from where we stood, to the floor below where the noodles, dropped from the slicers, moved along an endless conveyor above and to one side of the diffusion battery. This battery consists of fourteen big, cylindrical, iron cells, each one of which will hold five and one half tons of noodles. Men, stripped to the waist, were filling one of the cells, jamming the noodles into a manhole in the top of it as they poured off the conveyor. When that cell was packed full, the stream was turned into the next cell.

The operation of the diffusion battery is one of the surprises of a beet-sugar factory. You might suppose that the juice is pressed from the roots, like cider is pressed from apples. So it was in earlier times, but now the juice is removed by what physicists call the principle of osmosis.

You can perform a simple experiment which will show you how osmosis works. Take a long glass tube and cover one end of it with a sack, made of any minutely porous membrane. A small bladder will serve the purpose. Now fill the sack with thick sirup and immerse it in a basin of water with the glass tube upright and above the water. You will see the liquid begin to rise in the tube. Eventually it will flow out the upper end.



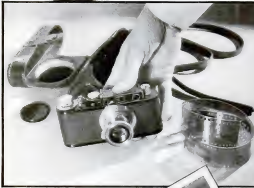
A centrifuge in the sugar factory being filled with the mixture of crystal sugar and molasses as it comes from the boilers to be separated

The explanation is that when water and sirup, or two sirup solutions of different density, are separated with only a porous membrane between them, they will diffuse through it until solutions of equal density have been formed on both sides. If there is room for the heavier sirup to expand, the water or lighter sirup will diffuse into it much more rapidly than it diffuses through the membrane in the other direction. If there (Continued on page 118)

Modern Wonder Cameras

SEE LIKE CATS IN THE DARK

Miniature-camera fan taking an action picture of a vaudeville act



Most of the remarkable photographs reproduced on these pages were made with this little camera. A roll of film is shown

NO ORDINARY CAMERA COULD MAKE PICTURES LIKE THESE

The larger picture is a snapshot made at night by electric light in a New York Automat restaurant. The two smaller illustrations show the actual size of contact prints made with the miniature camera. For most purposes, the pictures are enlarged

IF YOU should take a stroll through the brightly lighted area of almost any American city after nightfall, the chances are that you would encounter several suspicious-looking persons carrying strange little boxes with stubby tubes projecting from them. You would see them point these objects at theater signs, taxicabs unloading at the curb, attractive store windows, and pedestrians passing beneath brilliantly illuminated theater canopies. These are amateur photographers who have succumbed to the lure of cat's-eye photography, and find the taking of difficult nighttime photographs with the wonder cameras of today an absorbing hobby.

Times Square, New York, and the adjacent Broadway theater district are especially attractive to nighttime photographers because of the exceptional illumination provided by theater and other signs. Yet, even along this famous Great White Way, there are many curious folk who are frankly puzzled by the ultra-speed cameras.

The writer paused in the middle of a street one night to photograph a particularly attractive electric sign in Times Square. Out of the corner of his eye he saw a policeman hastily approaching. There was a look of curiosity on his face instead of the expected stern scowl.

"What are you doing there?" the officer inquired.

"Taking a picture," I explained. The policeman grinned wisely.

"Go ahead," he said, "but you won't get anything. There isn't enough light."

I explained to him in detail the abilities of my little camera; how it could make pictures that would have been considered impossibilities a few years ago, and how it was a close approach to the ideal instrument which can photograph anything the eye can see.

Whenever a group of amateur photographers assembles, there usually is at least one high-speed miniature camera present, and a few prints are being passed around to illustrate its latest triumphs. One owner of such a camera has built up a profitable business by producing unusual action pictures of stage performances, backstage and dressing-room activities, cabaret scenes, party happenings, and the like.

Of course, professional cameramen have not been slow in adopting the ultra-speed camera for difficult work. One large news-picture syndicate employs a man who does little else but experiment with ways of getting better pictures with the miniature cameras the staff men carry, as equipment auxiliary to their standard "four-by-fives." These little picture-making machines have created, in news-picture circles, a new field called candid photography, because they permit making informal pictures without the subjects' being aware of the fact.

Such stunts as photographing a stage juggler to show the Indian clubs in mid-air, or getting a picture of Greta Garbo simply by snapping the camera at a theater screen on which her image is being projected, have been made possible by the comparatively recent perfection of ultra-speed lenses.

"Impossible" Pictures Taken at Night and in Poor Daylight with the New, Ultra-Fast Miniatures Provide Novel Thrills for Amateur Photographers

By WALTER E. BURTON

The writer poses as a burglar to show the speed of modern lenses and film. Light was supplied solely by the match. The camera's shutter was left open, at lens aperture of F/2.5, as long as the match burned

A few years ago, a camera lens whose focal length was four and one half times its effective diameter was considered speedy. Now, however, lenses rated at F/1.5, which means that the focal length is only one and one half times as great as the diameter, are common. In photography, the method of stating the lens speed is to designate the ratio of the diameter of the opening to the focal length. The larger the diameter in relation to the focus—the smaller the ratio, in other words—the more light a lens will admit in a given fraction of a second.

Lens designers can produce speedier lenses if the focus is kept small. The size of the glass elements does not become impractical, and defects inherent in all lenses can be kept to a minimum. That is why, today, an ultra-speed camera is nearly always a very small camera, one of the "miniature" types so popular among photographers. Many of these cameras use thirty-five-millimeter motion-picture film. Others employ somewhat larger roll films, film packs, cut films, or plates.

Even the fastest lens that optical experts have been able to produce would be of little value in cat's-eye photography if it were not for the modern high-speed films. Because most nighttime and indoor snapshots are made by artificial light, and because such light, coming from electric lamps, contains mostly red and yellow rays, films must be sensitive to these colors. And so manufacturers have brought to a high state of perfection the so-called panchromatic or "every-color" films and plates. Such negative materials are sensitive to the blue light that affects all other types of plates and films, but they are also sensitive to greens, yellows, and particularly reds.

Theaters, inside and out, are favorite subjects for cat's-eye camera fans. A lighted sign was caught in the picture above. Right, acrobats by stage light

Such films, even when used with ordinary cameras having comparatively slow lenses, yield remarkable results. For instance, it is entirely possible to make an acceptable portrait of a person by the light of a single match. The red light so common in darkrooms not many years ago, and still used with "color-blind" and similar plates and films, gives enough illumination to permit photographing the darkroom interior on panchromatic film. Such film, incidentally, must be handled and developed in total darkness or by the light of a special green safelight lamp.

And so the photographer who sallies forth with a high-speed cat's-eye camera generally loads it with color-sensitive film or plates when he is seeking nighttime subjects, or those illuminated by late-afternoon or winter daylight.

The camera in which a remarkably speedy lens and a fast, color-sensitive film have joined forces to make difficult photography easy, has opened an entirely new field to photographers. There is a mysterious fascination in the making of pictures with such a camera. In fact, this fascination has had much to do with the development of the new hobby of miniature photography.

Possibilities confronting the owner of a cat's-eye camera are almost without number. He can go to a theater and obtain interesting and unusual pictures of stage scenes and even from the motion-picture screen, as long as he does not make a nuisance of himself by obstructing the view of other patrons. Circuses offer endless possibilities, even if the cameraman cannot attend a daytime performance. The field of informal home portraiture—snapping Junior while he is laboriously building a block castle on the nursery floor, or capturing a picture of the lady of the household while she is carving a juicy raisin pie in the kitchen—is attractive because it provides priceless souvenirs which would be unobtainable by ordinary photographic means. Many restaurants are lighted brightly enough to permit the making of ex-

(Continued on page 120)

SNOWSHOE-SHAPED RACKET MAKES TENNIS EASIER

DESIGNED to distribute strain evenly, a curious new tennis racket has made its appearance in England. The shape of its frame suggests that of a snowshoe. Branching arms form a "V" with a short handle at their bottom and a webbed oval for striking the ball is enclosed between them at the top. The inventor of the new racket is F. W. Donisthorpe, professional tennis champion of Great Britain in 1924-1925 and an internationally famous player of the game.

RESTORE OLD INDIAN VILLAGE

Workers completing the restoration of a primitive Indian earth lodge, under the supervision of members of the tribe

AN INDIAN village supposed to be 200 years old is being restored by Civilian Conservation Corps workers near Bismarck, N. D., with the assistance of Indians of the Mandan tribe, whose ancestors inhabited the original village. The earth lodges it contained, which are now being reproduced, were formed by a framework of heavy timbers, covered over with willow rods, coarse swamp hay, and finally earth and sod. Such lodges were waterproof, cool in summer and quite warm in winter. They ranged in size from one family homes to ceremonial lodges and lasted fifteen years or longer. Their inhabitants were a peace-loving agricultural tribe, fond of elaborate ceremonials and of tattooing for personal adornment, which caused them to become known, in sign language, as "the tattooed people."

Heavy timbers of the lodge being put into place

Locomotive turning itself under its own power

LOCOMOTIVE'S POWER OPERATES TURNTABLE

ENGLISH locomotives steaming into King's Cross Station, London, can now turn themselves around under their own power. A single-wheel tractor, geared to the turntable itself, is powered by a two-cylinder vacuum engine operated from the brake lines of the locomotive. When the engineer has run his locomotive onto the turntable, the fireman connects the vacuum brake pipe on the engine to a pipe on the tractor. The suction sets the double-acting oscillating cylinders operating.

HARD NEW ABRASIVE RIVALS DIAMONDS

SINCE the hardest material ever produced by man, named boron carbide, was introduced to industry not long ago, it has found many uses. Crystals of the new substance, called "synthetic black diamonds" because their hardness approaches that of real diamonds, are employed where only natural gems have served before. Dies of the new material have replaced diamond dies for drawing wire to great thinness. Bearings in electric meters and other delicate instruments are made from boron carbide. Its superior hardness to all other artificial abrasives has led to its wide use for cutting and lapping the new hard alloys used in modern tools.

A unique property of boron carbide, distinguishing it from other artificial abrasives, is that it may be melted and formed into molded shapes. Thus, high-pressure nozzles for blasting with sand or other materials may be made entirely of boron carbide, without the use of any bonding material of inferior hardness. Ordinary nozzles become worthless in a short time from the cutting action of the abrasive stream.

Boron carbide is known to chemists as a compound of boron and carbon, and has been a laboratory curiosity for years.

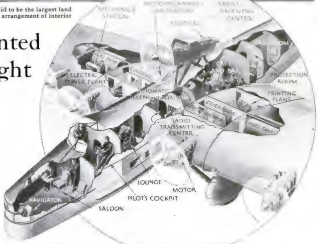
Sand blasting with a nozzle made of boron carbide

Left, lumps of boron carbide as it comes from the furnace where it is made from boric acid and coke

Below are shown nozzles and other products made from the hard new material for abrasive use

The *Maxim Gorki*, Soviet educational plane, said to be the largest land plane in the world. Right, cutaway view shows arrangement of interior

Newspaper Printed on Plane in Flight



A MONSTER airplane that carries a printing plant aboard is the Soviet's latest tool to educate the masses, in flying trips to outlying districts. Named the *Maxim Gorki* and called the largest land plane ever built, the huge machine measures 210 feet in wing span and weighs forty-two tons when ready for flight. Eight motors totaling 7,000 horsepower propelled it at a speed well in excess of two miles a minute, in recent successful flight tests.

The printing plant contains all the equipment necessary for issuing a complete newspaper during a flight. A rotary press designed especially for the plane prints as many as 10,000 copies an hour of an illustrated paper of twelve- by sixteen-inch size, for distribution on landing. Pictures taken during flight are prepared for the paper in a photo-mechanical laboratory aboard.

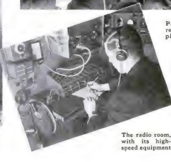
Movie shows may be given the populace by a folding screen carried in the rear of the plane and set up on the ground so that 10,000 spectators may view the show. The movies are thrown on the screen from a projection room within the plane, through a window in the fuselage.

Speech and music, from a microphone or phonograph within the plane, may be broadcast audibly so that they are heard by all those beneath, within an area of nearly four square miles. Other communication facilities of the plane include high-speed radio apparatus for transmitting routine calls and telegrams, and an intercommunication system aboard, a new departure in aviation. By switching a lever, the commander or navigator may address all occupants of the plane simultaneously in order to deliver instructions; while at other times the system is used for conversations between the various cabins.

Lounging and sleeping cabins for seventy passengers are furnished as comfortably as a hotel, and food is served from an electric kitchen during flight. An electric power plant of sufficient capacity to light more than 300 fifty-watt lamps, provides current.

Passengers taking refreshments in the plane's cozy cafe

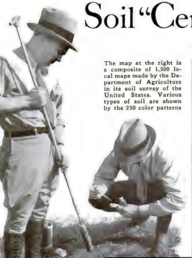
The printing press aboard the *Maxim Gorki*, which turns out 10,000 copies per hour of a newspaper while the airplane is in flight



The radio room, with its high-speed equipment

Soil "Census" Helps Farmers

HALF OF NATION'S ARABLE LANDS



Soil surveyors testing the deep subsoil for acidity. Samples brought up by an augerlike drill from a depth of several feet are tested at once

The map at the right is a composite of 1,500 local maps made by the Department of Agriculture in its soil survey of the United States. Various types of soil are shown by the 250 color patterns

TESTS MADE IN FIELD LABORATORY

Scientists recording the results of alkali determination test made with electrolytic bridge. Many other tests are made by the workers in the field

TAKING SAMPLES OF SOIL PROFILE

At left, surveyors are making records of texture, color, and density of the soil. Samples from the different land types are bagged and tagged for further examination by chemists in Washington

TWO hundred and fifty different color patterns bedeck a strange map of the United States that hangs upon the wall of a Washington, D. C., office, each pattern representing a particular kind of soil. The big chart is a composite of 1,500 local soil survey maps so far completed by the U. S. Department of Agriculture, which has just brought halfway to completion a monumental task it began thirty-five years ago —to survey and classify every parcel of arable land in the country, so that it may be farmed to the best possible advantage.

Each of the thousands of different types of soil in the United States is best suited for certain plants. The task of the surveyors is to identify each soil type and map its occurrence; then to determine what crops will grow best upon it, and to discover how it may be improved.

The first step in mapping a given area is a preliminary scouting exploration by an expert surveyor and one or more technical assistants, armed with an accurate base map of the region. Taking samples of the soil at quarter-mile intervals, they represent it on the base map by symbols such as "22" for "Susquehanna fine sandy clay" and "45" for "Elkton loam."

The boundaries of each type are entered upon the base map. Meanwhile, samples are taken methodically of each soil layer, to a depth of several feet, for more extended chemical analysis. These samples, together with the field maps, are forwarded to Washington.

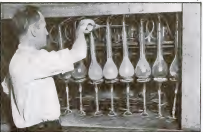
There chemists investigate the composition of a soil by separating it into its component parts. The percentage of these constituents tells much as to the possibilities of the soil.

Finally, in a central drafting room, the field sheets are revised to include this combined information, and are copied. The finished local map shows the types of soil in color and indicates their boundaries with reference to roads, houses, streams, lakes, and other landmarks.

Raise Better Crops

ALREADY TESTED IN GIANT SURVEY

Right, chemist starts the analysis of soil samples by separating them according to size of particles, as, coarse, medium, fine, and very fine sand; silt, and clay with colloid solutions



PRELIMINARY SURVEY OF SOIL TYPES

Surveyors getting a general idea of the types of soil before starting a detailed survey. As one explores with a shovel, the other marks a field sheet with numbers representing soil types

HOW THE FIELD SHEET LOOKS

Above is a typical detailed field sheet, showing houses and other landmarks. At right, a surveyor sighting through the alidade on the plane table to get the location of features of the landscape

The Man with the Net

DIAMONDS *now in circulation are valued at $70,000,000,000. Their combined weight is half that of a modern locomotive.*

INSECTS *have dialects just as humans do. A Washington, D. C., scientist reports crickets and katydids of the same species in different parts of the country have distinguishing chirps and trills added to their common calls.*

ONE HALF *of the shell of a giant clam is sometimes used by South Sea Islanders for a bath tub.*

THREE METEORS *an hour is the average number visible under ideal conditions from any given point on the earth's surface.*

FISH *have been caught in the Sahara Desert. Water from wells 300 feet deep brought them to the surface. It is assumed that underground rivers carried them to the spot.*

FIGHTING FROST *with dynamite is a new method used in the Middle West. Intermittent blasts during the night keep the air in circulation and prevent the premature frosts from damaging garden crops.*

TWO-WAY RADIO *conversations recently took place between an operator in Sidney, Australia, and a cruising police-type patrol car in Schenectady, N. Y.*

EXAMINATION *of the inner ear of a fish will reveal its age, according to an Eastern scientist.*

AUTOMOBILE FUMES *kill an average of three Americans a day.*

WARS *come when the sunspots are at their maximum; peace is most common when they are at their minimum. A French astronomer has reached this conclusion after comparing sunspot records with the history of the world.*

Your Microscope Reveals

Left, preparing the silica skeleton of an equisetum stem for examination under the microscope. In the circle is a photomicrograph of the skeleton showing the many-pointed projections which give this plant its value as an abrasive to smooth wood

TO MANY persons, the word "skeleton" suggests graveyards, death, or something to be kept in the family closet; but to the owner of a microscope it indicates a vast wonderland for him to explore.

Have you ever watched a man mowing grass with a scythe? He carries a whetstone in his pocket, and frequently has to sharpen the scythe blade. He may wonder why the blade dulls so quickly when it is cutting nothing but soft stems. If he had a microscope, he could solve the mystery easily. He would find that it is all because of skeletons.

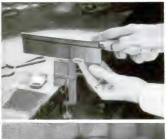
Many plants have skeletons that are surprisingly durable and, when seen through your magic lenses, even beautiful. The epidermis or surface layer, of stems, blades, and other parts of various plants, is composed of cells whose walls are impregnated with silica (silicon dioxide), one of the most abundant of materials. Similar silica deposits are found in the husks or chaff, and in the stems of many grains, such as rice and wheat.

One of the most extensive deposits occurs in the equisetum or "horse-tail" plant, which is commonly found along railroad embankments and is shaped somewhat like a Christmas tree. This plant also is known by various other names such as "scouring rush." It used to be a common practice to dry the equisetum plant and use it to scour pots and pans, and smooth wood. With your microscope you can see why the equisetum made so serviceable a scouring material. You will find that the entire plant is composed of glass-like silica.

To convert the silica skeleton of an equisetum stem or grass blade into a beautiful object for the microscope, you must remove the organic material. Place a small quantity of concentrated nitric acid in a test tube, drop the small pieces of plant material into it, and boil it over a gas or alcohol flame, taking care to keep it off your hands and clothing. Always hold the test tube with its mouth away from you, and heat it gradually, so that the glass will not crack. It is a good idea to have a generous supply of some kind of alkali solution handy, to douse on the acid if it spills. When the acid and its contained specimens are being heated, brown fumes usually form in the tube above it.

After the acid has boiled for a half minute or so, set the tube aside to cool; then fill it half full of water, to dilute the acid. Neutralize the acid by adding, a little at a time, some of the alkali solution. Bubbles of gas will form rapidly. When no more bubbles appear, the acid has been neutralized. Let the specimens, which are now almost entirely the silica skeletons of the plant particles, settle to the bottom of the tube. Gently pour off the solution above them, and add more clean water. In this way you can remove nearly all of the chemical matter in the solution.

To transfer the fragile skeletons to a microscope slide with a length of glass tubing, hold your finger over one end of the tube, lower the other end into the test



1 The first step in preparing a bone section. The bone is sliced with a fine-toothed saw

2 A drop of balsam is heated on a slide, and the piece of bone is pressed firmly into it

3 Set firmly on the slide, the bit of bone is filed down until it has been made very thin

4 After grinding to remove file marks, the specimen is polished on a smooth razor hone

Beauty in Skeletons

By MORTON C. WALLING

tube until it rests directly above the material you desire to capture, and then remove your finger. This releases the air imprisoned in the glass tube, causing the solution, carrying the specimens, to be forced upward by atmospheric pressure. By putting your finger over the end of the tube again, you can lift the solution with the tube.

You will find the silica skeletons to be objects of great beauty, particularly if examined with dark-field illumination or by polarized light. You can trace with ease the outlines of the individual cells that made up the plant tissue. At a magnification of 400 diameters or so, you can see the peculiar characteristic markings in the walls of many of these cells. Details of the hairs, stomata (breathing pores), and other structures will be found to be perfectly preserved in crystalline silica.

You will find it entertaining to examine various specimens of plant material for their silica skeletons. Take, for instance, a bit of the hull from a yellow canary seed. Its silica framework presents a complicated appearance, looking like parallel rows of knoblike formations interlaced with wavy lines running in parallel paths. Hairs found on the chaff-scales of most grasses are reënforced with silica.

FOR sheer beauty, there are few silica formations to rival that deposited in the equisetum tissues. The epidermis or outer cell layers are especially rich in the deposit. Examine a dry specimen, and then one immersed in water or balsam. You will discover that the entire surface is covered with what appear to be the spiked ends of tiny war clubs. Along the edges and places where the epidermal layer has been folded, these knobs stand out prominently.

Notice particularly the arrangement of the silica particles. A study of the specimen will reveal that there is order in the apparent confusion. Some particles seem to be arranged in parallel rows. But the most beautiful forms are produced by those that group themselves into ovals, resembling tiny jeweled necklaces. Here and there you can see a particularly complicated arrangement, the particles arranging themselves like a many-stranded necklace spread out in a form roughly square, with curved corners. These deposits generally occur in pairs. They mark the locations of the stomata, or breathing pores.

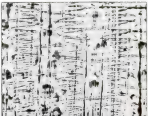
In the animal kingdom, the skeleton is highly important. Insects wear theirs on the outside, in the form of layers and plates of chitin, a remarkably durable substance. The shells of many sea animals serve as skeletons. Among the higher animals, the skeleton is a bony framework.

It is such bone that is to be subjected to the scrutiny of your microscope. You can use any bone that is available, although it is desirable to inspect as many different kinds as possible. Whalebone, beef bone, the bones of chickens, hogs, sheep, and a host of other animals ought to be easy to obtain.

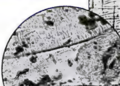
Preparing a bone for the microscope consists essentially of slicing it very thin in various directions. This slicing is not a difficult matter. First, remove the meat by boiling in water and then scraping with a knife. Let the bone dry. If it is greasy, soak it for a time in some solvent such as xylol or dry-cleaning fluid.

Cut rough sections with a fine-tooth saw. A small hand hack saw, such as are sold at ten-cent *(Continued on page 101)*

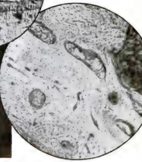
INSECT STRAIGHT-JACKET
At the right, the head of an insect is being studied with the aid of a paper cone that holds the bug still. Below, how the cone is packed with cotton



The maze above is the magnified silica skeleton of a husk of canary seed



Right, magnified section of veal rib, cut almost parallel to its length and polished



Lower right, a cross section of veal rib prepared for examination as described here

Below, photomicrograph of the head of the femur of a cat, as sliced lengthwise

Magic Lantern Sets Scenes in Theater

Left, realistic scene of Genoa waterfront, for a Shakespearian play, as thrown upon stage from projector above spectators' heads

Below, an artist is at work using brush and colors to depict stage setting on glass plate for projection in a theater

Above is shown the scene projector set up in the theater, while two operators stand by to shift scenes by quick change of glass slides

SCENERY for an entire play may be carried in a portfolio, through a method of projecting stage settings developed in Germany. Each of the desired scenes is hand-painted upon one or more glass plates and is thrown upon the stage by projectors high above the heads of the audience, much as a lantern slide is thrown upon a screen. To change the scene, it is necessary only to shift the plates in the projectors, transforming the stage at will into a landscape, the interior of a palace, or a wharf of a seaport, for example. Through skillful artistry in preparing the glass plates, the effects attained are said to show startling realism.

LITTLE DIRIGIBLE CARRIES OWN MAST

Here is a baby blimp, designed for private owner, moored to its own portable and collapsible mast which is said to enable it to land where it will

A BABY blimp that carries its own mooring mast is the latest creation of Anton Heinen, of Lakewood, N. J., in his efforts to popularize small dirigibles as private aircraft. The mast enables the craft to land in small airports where standard mooring facilities are not available. It is shown in use in the accompanying photograph of the blimp at Washington, D. C., during a recent visit. Guy wires steady the mast.

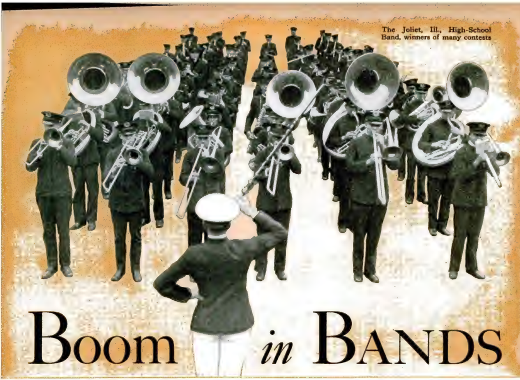
HARDY PLANT RESETS ITSELF

A PLANT so hardy that, if uprooted by a windstorm, it grabs hold again wherever it lands, is one of the trophies of Federal plant scientists just back from a seven-month search in Turkestan for drought-resistant varieties for introduction here. Since it "lands on its feet," it can take root again and survive. Seeds of this desert grass, which is shown above, and of nearly 1,800 other plants, some edible by livestock and others useful in checking soil erosion, were brought back by the explorers.

Its reflector buttons make this car license shine out

CAR LICENSE GLOWS AT NIGHT

EASY to read at night, an automobile license plate using reflector buttons to outline the numerals is put forward by its inventor as a means of combating crime. Under the rays of a street lamp or the headlights of an approaching car, the illuminated numerals glow brightly and make it easy to spot the number at an appreciable distance.



The Joliet, Ill., High-School Band, winners of many contests

Boom *in* BANDS

PUTS AMERICA IN MARCH TIME

By
Earl Chapin May

FOR three hot hours of a June Saturday, an excited multitude in Drake Stadium, Des Moines, Iowa, watched bands from Massachusetts, Colorado, Michigan, Ohio, and Iowa contend for prizes in marching. The spectators cheered like football fans when the marchers joined 5,000 other boys and girls and closed the Eighth Annual National High-School Band Contest by a thrilling rendition of Sousa's *Stars and Stripes Forever*.

The moment official awards were announced, there was a rush to wire good or bad news to friends and relatives in communities actively interested in a contest between the pick of the 20,000 school bands which are increasing American harmony. Chosen by local, state, district, and national tryouts, the youthful contestants represented the best amateur performance on reed, brass and percussion instruments. They were the net results of a boom in bands which began two decades ago as an outgrowth of a boom in drum corps described in the September number of POPULAR SCIENCE MONTHLY.

Drum corps date from colonial days, and our first important military band was organized shortly after the Revolution. Our oldest amateur band in point of continuous existence is the Stonewall Brigade Band of Staunton, Va., organized in 1845. But the myriads of juvenile school bands trace their descent from the Farm and Trades School Band organized during 1858 on Thompson's Island in Boston Harbor.

Like most other amateur bands, the Boston organization was started by kids who, probably inspired by brilliant though brassy circus bands, made "music" through tissue paper spread on common hair combs. These hair-comb musicians were joined by three young violin scrapers. Later additions were a bass fiddle or double bass; a saxhorn (which resembled the modern alto), and a cornopean, ancestor of the modern cornet.

TWENTY THOUSAND American communities support school bands which are trained by experts and stimulated by colorful national tournaments. This amazing new movement, transforming the old "town band" into a crack musical organization, is described by Mr. May, who recently told of the similar boom in drum and bugle corps

A teacher named John Ripley Morse developed this nucleus into a band which became part of a thousand-piece organization directed by the famous Patrick S. Gilmore at the Boston Peace Jubilee of 1869. Keeping pace with the times, it won first place in its class at the 1929 Massachusetts Boys' Band Contest and first prize at a subsequent New England Band Contest.

In the meanwhile, American youth ran amuck with the band idea. Before our current movement for better and bigger bands for juveniles was initiated, most small-town amateur bandsmen were terrible. I know, because I was one of them. As a boy cornetist, side-stepping lung trouble, I barged into leadership of the Rochelle (Ill.) Kid Band which grew into the Rochelle Military Band with a silver cornet painted on its bass-drum head.

We blew blue notes in imitation of our elders. The local undertaker taught us gratis. The group disbanded every fall, after cashing in on Fourth of July and county-fair engagements. Captious citizens often cussed us. Less crabbed ones dropped coins into our hats and thus gave us a fresh start each spring. This program was followed by most of our tooting con-

THE FIRST FARMERS' BAND

Right, the Page County Farmers' Band, of Iowa, all real farmers. Below, a diminutive bandsman with the helicon model tuba, biggest of horns

temporaries. The Silver Cornet Band was colorful, but it and its public suffered from lack of professional guidance and systematic sponsorship.

Contests have taken most of the curse out of our amateur band performances. Local pride has been replaced by sensible supervision. Amateur band music has become enjoyable and cultural. Its improvement can be properly credited to the Landers Band Tax Law and the contest idea.

Major George W. Landers, of Clarinda, Iowa, started a movement in 1921 for legislation to permit minor cities to tax themselves for support of municipal bands. The law has been adopted in forty-eight states. Major Landers, well in his seventies, is one of the few reformers who have lived to see their reforms really working.

The contest idea, sponsored by the National Bureau for the Advancement of Music, the Music Educators' National Conference and finally by the National School Band Association, began in 1926 with a national band contest at Fostoria, Ohio. Ten states selected would-be champion bands by competitive eliminations. The members of each band were selected by section competitions. A section is a division composed of the same or related instruments, such as reeds or brasses.

Thirteen bands—one from as far away as Ogden, Utah—participated in that Fostoria contest. Fostoria's 10,000 citizens were hosts to the visiting band boys, who were not allowed to spend a penny in the Ohio community. The Joliet, Ill., High-School Band won on performance, appearance, and marching, by a fraction of a point.

Joliet won again at Council Bluffs, Iowa, in 1927. In 1928, it won in its own home town, although Modesto, Calif., spent $15,000 of publicly subscribed money to send its boys' band to Joliet in private Pullman cars. The Joliet High School Band thus gained permanent possession of the national championship trophy, and could not attend the Denver contest of 1929 except as guest band with Director Archie McAllister, its conductor. But the citizens of Joliet raised the expense money, largely through selling "Send the Band to Denver" buttons.

At Denver, the Nicholas Senn High School, of Chicago, topped them all, including persistent Modesto. It repeated this performance at the 1930 Flint, Mich., contest. Then Joliet, permitted to reënter the arena, carried away first prize for all class-A bands at Tulsa, Okla.

By this time, the official National Contest had become so popular that it was necessary to classify the bands. Class A came from schools having more than 750 enrolled pupils; class B from schools having from 250 to 750; class C from schools having less than 250 enrolled pupils. By 1933, when seventy-five bands contested at Evanston, Ill., it was necessary to substitute for "first prize" in class A an "Outstanding Band" designation. Joliet got away with that one, too.

Bandmaster Archie McAllister might never have been a master of America's champion high-school band or president *ex officio* of the National School Band Association had it not been for his lean-

The nattily uniformed band of Manhattan College, New York City, marching past the reviewing stand in a parade. Mayor LaGuardia stands back of flag at left

THE BOY CORNETIST
The photograph below shows the author as a cornet soloist in his college days. He found horn-blowing an excellent preventive for lung trouble

ing toward woodworking. Although he bought a brass cornet and started a rural band near Joliet in his youth, he had gone into Montana fruit ranching to make a living. As an avocation he turned to woodworking. His ability in his home workshop attracted the attention of the Jewish Training Schools in Chicago, which engaged him to teach carpentering and manual training. He later went to Joliet to do similar work in its public schools.

Archie's first band of twelve young members rehearsed in his carpenter shop. He started his first public-school band with a $2 allowance for each rehearsal. This band was unpopularly known as "The Disease." By choosing members for loyalty, as much as ability, he began to win prizes. Then he got a real salary as director and a trip for his band to Washington, D. C.

Archie McAllister's method with the Joliet High School Band is typical of many of his competitors. He picks his players from all classes in a city of 60,000. Solo competitions for national prizes are among the later wrinkles in high-school band contests. Leonard Bradley, Joliet's solo-oboe prize winner, is the son of a mail carrier; Raymond Tremmeling, who has won national prizes as a clarinetist, is the son of a street-car motorman; Robert Harris, prize-winning French-horn player, is the son of an undertaker, while Glenn Henderson, twice winner of the national prize for cornetists, is son of an electrician. And there are several farmers in that band.

Jack Wainwright took Charles Munger off a farm near Fostoria and taught the boy to hold his mouthpiece loosely against his lips, to breathe from the diaphragm like a singer, to depend on his tongue for attacking a tone. In four years young Munger played a cornet solo with Sousa's Band before 20,000 visitors at the Ohio State Fair!

Of course, the first step in selecting recruits and assigning them to instruments is to test them for tone sense. An easy method is to play a tone like C or G on a cornet or piano, then ask the pupil to sound the same tone on his instrument. If the pupil can not do this readily, the teacher switches him to drums or cymbals where only a sense of time or rhythm is necessary.

Assigning pupils to instruments depends largely on the teeth. If a pupil's teeth project abnormally, he is not destined for wind instruments. If upper and lower teeth overlap, they will make trouble in cornet playing. If they are large and meet evenly, they approach the ideal. If the lower teeth recede, they are almost hopeless for any horn with a small mouthpiece, which should be held at right angles from the teeth. This applies to all reed instruments except clarinets, which can be played with the bell pointing downward at an angle of thirty-five degrees.

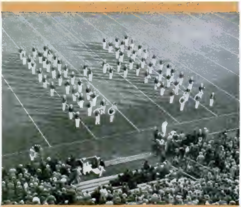
The lungs, of course, figure in wind-instrument playing. Dr. James F. Rogers, of the United States Bureau of Education, has proved by statistics based on a study of hundreds of prominent musicians who lived between 1700 and 1900, that players on wind instruments live longer than the average. In certain cases, playing the saxophone, the flute, or the cornet has definitely stayed the progress of tuberculosis. But the formation of the teeth is all-important, for it is "tonguing," and not blowing, that makes a good wind-instrument player.

Tone is made, primarily, on any musical instrument with a cup-shaped mouthpiece, by the tongue's attack. Hence you will never see a good bandsman puffing out his cheeks when playing. While Frank Fitzgerald was director of the Rockford, Ill., Military Band he might be the only cornetist on a march down Main Street, but you could hear him at all times above forty other instruments. He weighed less than 130 pounds, and was not barrel-chested. A dimple showed in each cheek while he played. But he got plenty of volume while hitting high C's and high E's, because he used his tongue properly and played with the "non-pressure system."

This system was then a novelty. Under it, high tones were made by contracting loose lips, which thus did not become sore or grow

A BAND OF 1845. First members of the Stonewall Brigade Band of Staunton, Va., now the oldest amateur organization in the country weary from "punching" and vibration, and were not deprived of their natural blood circulation. The bands from Mason City, Iowa, and Harrison High School, of Chicago, and the famous band from Joliet, could not have won the three highest honors at Des Moines last June if their members had depended upon blowing into instead of tonguing their instruments.

Moderately thick lips do the best work in metal, cup-shaped mouthpieces. Size of player and size of instrument are not necessarily associated. B. A. Rolfe, distinguished band leader and brilliant cornetist, is notably tall and ponderous. Clara Bloodgood, weighing 110 pounds, plays the exceedingly difficult "triple-tongue" solo (written originally for the cornet), *Levy-Anthem Polka,* on the Sousaphone, largest of all brass instruments. And she doesn't get red in the face or puff out her cheeks, although the Sousaphone is a double B-flat bass horn weighing thirty pounds—sometimes forty, depending upon the thickness of metal tubing used.


The Harvard University band in a fancy drill movement, forming the letter "H" in front of the stands at a football contest

Possibly made curious by the impressive development of school bands, Prof. Carl E. Seashore of the University of Iowa and Prof. Elmer E. Jones of Northwestern University have made elaborate laboratory tests on more than 5,000 students to determine alertness, rhythm, dexterity, precision, memory, and coördination of brain and muscle possessed by prospective instrumentalists.

So far, most of the amateurs join bands through pure love of music. Intelligent instruction keeps them going.

The Arthur, Ill., High School has 160 pupils. Its class-C band of eighty-two members, directed by George C. Wall, was creditably placed in the second division at the 1933 National Contest. The school maintains a second or "feeder" band of twenty members.

Four years ago the Washington High School Band of Sioux Falls, S. D., had practically no musical experience. Director Arthur H. Thompson took hold of it. The band now permanently possesses a first-prize trophy won three times in succession in state contests.


Between the halves of a Yale-Princeton game, the Yale band displays a "Y" before the Yale cheering section

Winning bands must play classical selections with sixty or more able members and a balanced, symphonic instrumentation. Most class-A bands have 100 members.

Lenoir, N. C., has a population of 4,000 and a high-school band originally sponsored by the local post of the American Legion. That band started the high-school contest idea in North Carolina, as a class-B band. It got so good it had to step up and compete, under a handicap, with class-A bands from cities ten times larger than Lenoir. But it kept winning prizes.

Last year the North Carolina State Legislature made drastic cuts in school appropriations which threatened to put an end to systematic school music. The citizens of Lenoir promptly voted to pay a tax to keep its band going.

In addition to pointing steadily toward state and national contests, nearly all school bands hope to have representation in the National High-School Band which is instructed by eminent musicians for eight weeks each summer at Interlochen, Mich. This band camp is unique.

The 200 or more members of the National High-School Band are carefully selected by local music supervisors and by Dr. Joseph E. Maddy of the University of Michigan. The band feeds into the National High-School Orchestra.

Dr. "Joe" Maddy, father of the Camp at Interlochen, believes that ten years from now each of our cities of more than 10,000 population will be supporting a genuine, all-American symphony orchestra. Maddy, who came up from a small town band, is not a visionary. He is supremely practical.


The seven deep-throated basses of the band of the University of Southern California, grouped together for a little close harmony. This band is distinguished by its unusual uniform, consisting of plus-fours and sweaters

Home Tests for the Amateur Scientist

SPECTRUM ON A PHONOGRAPH DISK Hold a phonograph record so that a bright light is reflected from its surface at a wide angle, and you will see the colors of the spectrum. The grooves on the disk act as a "diffraction grating" and produce the same effect as a glass prism. Such gratings are sometimes used scientifically in place of glass prisms for breaking light into colors

HOW CLOUDS ARE MADE. Place a few drops of water in a bottle and evacuate it of air with the lungs as shown. A flashlight will reveal fog formed in the bottle by cooling due to expansion

EXPANSION OF METAL. A metal rod placed as illustrated above, and heated with a match, moves the cardboard pointer pivoted at its top, thus making its elongation visible

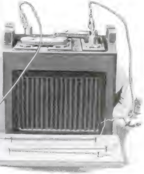
DEMONSTRATING INERTIA. A book is suspended by a string as shown above, and another string is tied below it. A quick pull breaks the lower string, inertia holding the book in place

MAGNETISM IN WIRES. A current flowing along two parallel wires connected at the ends will cause them to attract each other, due to magnetic fields set up. When it passes through a wire doubled back upon itself, the two sides repel each other. Picture below shows set-up

HEAT CONTRACTS RUBBER. Unlike most substances, rubber contracts when heated. The band stretched as in the photograph above will shrink when heated, and lift the heavy pliers

PERSISTENCE OF VISION. A piece of wire, bent to form half of a figure, is rotated between the hands as illustrated above. Your eye will see the figure entire, because the retina of your eye retains the image impressed upon it

A PRESSURE PARADOX. When an ordinary marble is placed against the nozzle of a squirting hose, as at the left, it will stay in place. Atmospheric pressure keeps it from being pushed away by the stream



FIFTEEN TIME-SAVING

HOUSEHOLD Inventions

CHILD'S EATING SET. This practically unbreakable outfit will save the family china. The dish is divided into compartments for food, and has a well for the tumbler. A flange on the edge makes it almost impossible to tip it over

VERSATILE KNIFE. Cutting the skin of an orange, as shown, is one of the many home tasks for which this odd-shaped knife is suited. Two blades on the same side adapt it for scraping paint off glass, cutting cardboard, and many other purposes

INDIVIDUAL PERCOLATOR. Coffee can be percolated right in the cup with this clever device, which has a 220-watt immersion-type heater in the middle of the coffee basket. It may also be used as a heater for water or milk

FLEXIBLE TOASTER. This three-slice toaster will make one or two slices without wasting current, as the heaters for the empty chambers can be turned off. When toast has been made, a small heating unit keeps it warm

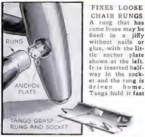
TOWEL RACK FOR SINK Towels are kept conveniently on this handy rack, which is easily attached without tools to the kitchen sink and is rigid and permanent. A similar model is available for use on wash basins of usual design

COFFEE AS YOU LIKE IT. With the automatic percolator shown above, you can be sure of having coffee weak, medium, or strong, as preferred. The dial is set for the strength desired, and the automatic control does the rest

SASHLESS WINDOW. Two metal-bound panes of glass, forming this new sashless window for homes, slide easily on bearings in a weather-stripped groove. A tempered spring catch snaps to lock the window when it is closed. Photo at left shows inventor demonstrating the use of the window with a working model

HAMMER AND NAIL KIT. This handy outfit provides a box with six sizes of nails, and a hammer with a magnetized end which makes it possible to pick out a nail without pricking the finger. The box has six compartments and a rotating top turned with the hammer, which can be easily inserted

KITCHENROBOT This electric servant washes and irons the clothes; washes and dries dishes; mixes drinks, whips cream, and beats eggs; chops meat, churns butter, and extracts fruit juices; polishes the silverware and sharpens cutlery. When not in use, it folds out of the way under the sink, as illustrated herewith

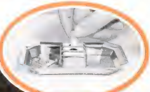


FIXES LOOSE CHAIR RUNGS A rung that has come loose may be fixed in a jiffy without nails or glue, with the little anchor plate shown at the left. It is inserted halfway in the socket and the rung is driven home. Tangs hold it fast

GUARDS NURSING NIPPLE The glass cap shown above keeps the nipple of a nursing bottle sterile until feeding time. This makes it possible to put on the regular nipple when the bottle is filled, instead of a temporary cap

KITCHEN PAPER RACK. Four kinds of paper useful in the kitchen are kept conveniently in rolls on this wall rack. They include waterproof paper for wrapping garbage; heavy waxed paper for general use; parchment paper for cooking, and paper for drying hands

TO KEEP SILVER BRIGHT. The jar shown above contains a chemical which absorbs tarnish-producing vapors from the air in a silver drawer. It is merely opened and placed in the drawer, and is said to prevent tarnish very effectively



NOVEL ASH TRAY. A center rest for cigarettes, in the safety ash tray pictured above, prevents them from igniting matches or stubs, or dropping to the floor

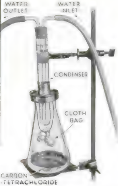
NON-TIP BEVERAGE TRAY. The tray at the left makes it easy to carry glasses without tipping them over. Slots are provided for stems of wine and cocktail glasses, and circular places for highballs

Experimenting with SOAP *and*

IN THE AMATEUR

By
RAYMOND B. WAILES

How fat can be extracted from foods. Carbon tetrachloride vaporized in the flask condenses and drops onto a cloth bag holding the fat-containing substance. It dissolves the fat and deposits it in the flask



AS LONG as your home boasts a kitchen closet, you need never look far for interesting chemical tests. Such things as butter, gelatin, cereals, and soap may be just household articles to the housewife, but to the wide-awake experimenter they represent chemicals that enter into a host of important reactions.

In the chemistry of soap alone, your home laboratory can provide hours of fun. By combining two simple substances that are found in every home you can make your own soap, or by making use of an inexpensive chemical you can test the commercial soaps sold by your grocer.

Although butter, linseed oil, lard, or any fatty, greasy material can be used as a basis for homemade soap, the amateur will obtain better results if he spends a few cents for a bottle of olive oil. About one hundred cubic centimeters (slightly less than a half a glass) of the liquid will be enough for a fair-sized batch. Simply pour the oil into a suitable glass container and add a cold alkali solution made by dissolving fifteen grams of sodium hydroxide (lye will do) in one hundred cubic centimeters of water.

As the materials are mixed, a curdy white precipitate will form. This reaction, continuing for two or three days, is called "saponification" and results in the formation of the soap. In this case, the soap will be of the sodium-oleate type and glycerin also will be formed.

When the white curd is completely precipitated, all that remains is to remove the actual soap from the solution by separating it from the water. This process, known as "salting," consists of adding a solution of about two ounces of salt dissolved in four or five hundred cubic centimeters of water. In a short time, the soap will separate from the liquid and float at the top of the container. It may be a trifle pasty at first, but it soon will lose its water as it dries. Eventually, the soap can be gathered and, after an additional drying period, poured into cardboard moulds. In color, the product will resemble Castile soap.

If a liquid soap is desired, cocoanut oil or linseed oil should be used. From the home chemist's standpoint, the latter will probably be the least expensive and easiest to obtain. Thirty grams of potassium hydroxide (caustic potash) first should be dissolved in a mixture consisting of seventy-five cubic centimeters of water and fifty cubic centimeters of alcohol of the grain or rubbing type. This alcoholic potash solution then is added to about one hundred and fifty cubic centimeters of linseed oil. Finally, the bottle should be stored in a warm place and shaken at intervals during the next few days.

Eventually, when the saponification is complete, two hundred cubic centimeters of a half-and-half mixture of alcohol and water should be added to dissolve the soap, giving the liquid a clear brown color. If desired, a really professional product can be made by adding some inexpensive scenting oil such as oil of spearmint or oil of sassafras as a finishing touch.

The main secret in obtaining a good soap is to strike a balance between the caustic and the oil. If too much caustic is used, an excess will be present and the soap will be harsh to the skin. On the other hand, if too much fat or oil is used, the soap will be greasy. Along this line, you can test your own soap or any soap for excess caustic by touching it with a drop of phenolphthalein. If the drop turns red, there is free alkali in the soap.

Although no one could fail to recognize a piece of ordinary fat, few people realize that this selfsame substance is contained in cereals and cheeses. By making a simple piece of apparatus, the home chemist actually can extract the fat from such foods.

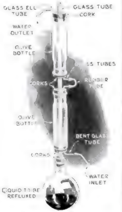
The extraction apparatus consists of a wide-mouthed flask supplied with a tin-can cover and sleeve designed to support a test tube. Held in a vertical position in the neck of the flask and fitted with a cold-water inlet and outlet, this tube acts as a condenser. A piece of wire bent in U-shape and soldered to the underside of the cover so that its lower end extends below the test-tube condenser, serves to hold a cloth bag filled with the crushed material being tested.

With the test material in place, carbon tetrachloride is poured into the flask, the circulating water for the condenser turned on, and heat applied. As the carbon tetrachloride is vaporized it rises, is condensed

Butyric acid, made from butter, shows an acid reaction when distilled and passed into an alkaline solution containing phenolphthalein

Other Household Chemicals

LABORATORY



Drawing and photograph show the refluxing process by which gelatin can be prevented from setting and broken down into its component substances

on the sides of the test tube, and drops in a steady stream onto the cloth bag. Being a good solvent for fats and oils, it dissolves any extractable material that may be present and washes it into the flask.

After several hours, all of the fat contained in the material under test will be part of the solution in the flask. To reclaim it, simply store the open flask in a warm place. In time, all of the carbon tetrachloride will be vaporized, leaving the fat. If the final solution is turbid, a preliminary filtering may be necessary before finally setting it aside.

Fats liquefy when gently heated, but when the temperature is raised sufficiently, they decompose. The product is an offensive and poisonous gas known as "acrolein." It is this gas that causes the eyes to smart when exposed to the dull, white vapors given off by burning, fatty meat.

Because this gas is formed by the decomposition of the glyceride component of the fat, it also can be produced by allowing a drop or two of ordinary glycerine to fall on a hot plate; this fact makes it a simple matter for the home chemist to test automobile anti-freeze solutions for the presence of glycerine.

Few people would say that an acid could be made from butter, yet in the home laboratory it becomes a simple experiment. To some melted butter in a flask, add enough caustic, such as sodium hydroxide in solution, to form a soap. Then, carefully add strong sulphuric acid, a drop at a time until the liquid gives an acid reaction by turning blue litmus paper red. This will transform the sodium butyrate, formed by the reaction between the sodium hydroxide and the melted butter, into sodium sulphate and butyric acid.

Finally, heat the mixture gently in a retort or a distilling flask. The butyric acid will distill from the liquid, and, if allowed to pass into a weak solution of an alkali colored red by the addition of a drop of phenolphthalein, it will remove the color, indicating that an acid is present.

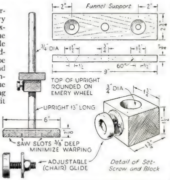
Even beef-tea cubes can be used by the home experimenter. By means of a series of simple tests he can identify the various substances used in their manufacture. First of all, the cube should be placed in an evaporating dish and heated until it is almost colorless. During this process the unmistakable odor of acrolein gas will be noticed. This indicates the presence of fat.

When it has cooled, tasting the substance will indicate that it is mainly salt, while a close inspection under a lens will show the same crystal formations as those of ordinary table salt.

If he desires, *(Continued on page 117)*

Filtering Stand *for the* Home Chemist

IF YOU haven't an adjustable filtering stand for your home laboratory you can build one easily and inexpensively. With the exception of the metal screw, which is an adjustable chair glide obtainable at most hardware stores, the entire unit can be made from pieces of scrap wood and a short length of dowel. As all funnels have a sixty-degree angle, the support can be used for all filtering needs. Having two funnel holes, it allows two filtering operations to be carried on at the same time. The angular holes can be formed with a rat-tail file after small holes have been drilled at the proper points. The slots in the underside of the base are added to the design to prevent undue warping.



Coil-Winding

How a weight is used to provide tension in winding a coil. Both hands are left free to turn the coil and guide the wire

WHAT is the most difficult step in the construction of a simple short-wave receiver?

Pop that question to the average set builder and chances are he will name the chore of coil winding. Yet, by following a few simple rules and handy short cuts, even the beginner can turn out plug-in coils worthy of a professional.

In its simplest form, a plug-in coil consists of three individual but closely related parts—the pronged form which serves as a core for the coil as well as a means of connecting it into the circuit, the small tickler, and the larger grid winding. If tested coil specifications are being followed, accurate values for each of these items will be furnished. The required diameter of the coil form will be specified in inches, the number of turns and the kind of wire indicated, and directions included for spacing the windings as well as the individual turns.

Naturally, the first job is to obtain suitable forms for the number of coils required. In this step, the amateur can choose from an almost unlimited array, ranging from smooth cylinders of fiber composition to forms of white isolantite fitted with handles and conveniently drilled to take the leads from each winding. Just three requirements govern the choice: the effective diameter of the form, the overall length of the coil, and the number of connecting prongs.

Where cost is an important factor, many amateurs improvise inexpensive coil forms by making use of the composition bases of discarded vacuum tubes. Available in diameters of one and one eighth and one and three eighths inches, and fitted with four to seven prongs, depending on the type of tube, they make ideal coil foundations.

Either of two novel methods will simplify the task of removing the glass bulb from the tube base. A hot water bath can be used to loosen the cement so that the bulb can be twisted loose, or the glass envelope can be wrapped in a cloth and smashed with a blow from a hammer. In the second method, the cloth is an important safety precaution against flying glass and should not be omitted.

After most of the glass has been removed, the remainder of the cement in the base can be scraped out with a knife. Finally, the wires leading to the prongs can be loosened by touching the hot tip of a soldering iron to the end of each prong and pulling the lead free with a pair of pliers. Since the prongs are to be used again as connections for the winding leads on the completed coil, care must be taken not to damage them.

Although there are no rules regarding the locations of the windings on the forms, most amateurs find it convenient to place the grid coil at the bottom nearest the prongs and the tickler above it, winding them in the order named. This not only insures short leads to the prongs but also allows maximum space for the windings.

The first step in winding the coil consists of drilling a small hole in the coil form at a point about one quarter inch above the bottom edge. This serves as the lead hole for the bottom end of the grid winding. The wire to be used should be threaded through it for a few inches and then wedged tightly in place with a short length of sharpened toothpick or match stick forced into the hole.

With the end of the wire fastened

The "walking-up" method of coil winding is illustrated in the circle. The winder walks toward the vise as the coil is turned. Above, the simplest way to remove a glass bulb from a tube base, by wrapping it in a cloth to keep glass from flying, and smashing with a hammer

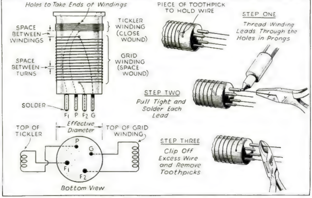


Diagram shows wiring of plug-in coil and how winding leads are finally connected to the prongs

Tricks *for Set Builders*

These Simple Yet Effective Methods Will Help You Over The Most Difficult Task In Building a Short-Wave Set

By

GEORGE H. WALTZ, JR.

firmly, the actual winding of the coil can be accomplished in any one of a number of ways. The so-called "walking-up" method consists of fastening the outer end of the wire between the jaws of a vise, holding the coil form in your hands, and walking toward the vise as the form is turned and the wire wound in place. Plenty of tension can be applied to the wire in this way and a tight winding is almost certain to result.

Another method consists of fastening a small weight to the outer end of the wire and slipping the coil form over a small-diameter rod of wood or metal gripped horizontally in the vise to serve as an axis. Both hands can be used to turn the coil and guide the wire while the weight furnishes the necessary tension. When a winding requires an exceptionally long piece of wire, the weight can be moved along the wire as the winding progresses.

A clever stunt often used by amateurs who desire a tight winding that will stay tight is that of expanding the wire before it is used by placing it in a moderately hot baking oven for five or ten minutes. Wound on the form while expanded, and fastened at its ends, its tension naturally increases as it cools and contracts.

When the final turn on the grid coil is reached, a second hole, of course, must be drilled to take the wire. Allow at least three inches of excess wire at the end of the winding, thread it through the hole, and finally wedge it in place with a piece of toothpick. Remember, each end of each winding must be connected to the prongs at the base of the form, so it pays to be generous with the excess.

Just where the tickler coil is placed will depend on the distance required between the windings as given in the coil specifications. If the spacing is indicated as one eighth inch, the hole for the lower end of the tickler should be drilled exactly one eighth inch above the hole at the upper end of the grid winding. Then, when the tickler is completed a fourth hole must be drilled to take the final lead to the prongs. In each case, a toothpick wedge should be used to hold the wire firmly in the hole.

Incidentally, in drilling holes in coil forms, a small drill is not absolutely necessary. A good substitute can be made by grinding or filing a brad or finishing nail to a sharp V-shaped point.

Once both windings are in place and held firmly by the toothpick wedges, all that remains is to connect the winding leads to the prongs. How this is done is shown in the sketches. Each wire is first threaded through its respective prong so that it projects through the hole in the tip. Then, with the coil form held in a vise, the wires are pulled tight one by one, soldered in place, and the excess clipped off. Use good solder and be sure that both wire and prong are clean before you begin. A loose connection at a prong can cause all sorts of trouble. When the soldered connections have been made, the toothpick wedges can be removed.

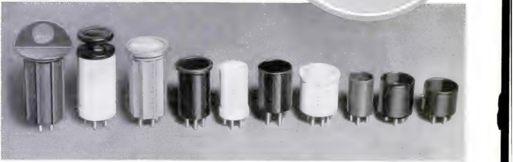
Although there are no definite standards as to which prongs on the coil form should be connected to the tickler and which to the grid winding, a convenient arrangement followed by most manufacturers and many amateurs is indicated in the drawing of the sample coil. The letters F_1 and F_2, P, and G refer to the usual filament, plate, and grid prongs on the conventional vacuum tube.

In coil winding, two general types of coils or windings can be specified—close-wound and space-wound. In a close-wound coil, as the name indicates, the turns are applied close together, while in a space-wound unit the turns are spaced from their neighbors at a specified distance. Space winding is common on short-wave coils, especially in the grid coil.

Space winding can be accomplished in various ways. One simple method consists of winding a thread or cord on the coil along with the wire. If the spacing between turns is specified, a thread or cord of that diameter will space the turns just the required amount. On the other hand, if the number of turns per inch instead are given, a few trials with strings of various diameters soon will give the right spacing.

(Continued on page 121)

Photograph at right shows how a commercial coil form can be used as a container for a coil. The handle is used for a cover



A few of the many types of coil forms available to the amateur set builder. Note that some types are drilled for winding leads, eliminating this work

VALUABLE HINTS FOR Radio Workers

Fills Cabinet Scratches

A SIMPLE way to remove scratches from radio cabinets is provided by a combination filler and polisher now on the market. Resembling a bullet, this inexpensive aid provides a special color filler as well as a polish and removes scratches from dark and light wood alike. First, the filler crayon at one end of the handy container is rubbed over the scratch as shown above. This fills the depression, and an application of the polish from the pad at the other end completes the operation. On shallow scratches, the filler can be omitted, the polish alone serving to erase the mark.

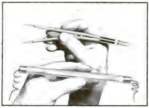
Placing the Loudspeaker

ALTHOUGH few radio owners realize it, the position of the receiver in a room has a great deal to do with its tone. First of all, it is never good practice to place the back of the receiver cabinet flush against the wall. Its rear edges should be at least an inch away from any vertical surface. If the room is long and narrow, a loudspeaker generally will give best results if it is placed at one end instead of at one of the sides. Also, if you have one favorite chair in the room, it should be in line with the speaker but not too close to it; distance lends enchantment to most loudspeaker tones. Since every room presents its own problems as far as sound is concerned, a little experimenting on the part of the amateur will be both interesting and effective.—L.J.K.

Novel Telescoping Portable Antenna

WITH the increasing popularity of the ultra-short wave lengths comes a new type of portable and adjustable antenna especially adapted to this kind of reception. Made of close-fitting sections of duralumin tubing in the manner of a telescope, it can be collapsed or extended easily and quickly to give the best results. Once the rod is in position, ingenious slip fasteners lock the sections rigidly in place. Designed particularly for two- and one-half- and five-meter work, these antenna rods are available for either ground, airplane, or automobile stations. When mounted on a car, the rod is fastened by means of a sturdy insulator to the radiator cap as illustrated in the photograph at the right. In this case, the car's body and chassis serve as a counterpoise, a clip on the radiator cap acting as the terminal.

Neon Fuse Guards Against Excessive Voltage



MOST fuses protect equipment from excessive current, blowing when the amperage reaches a certain point. The recently designed neon fuses shown here, however, are a protection against excessive voltages. Besides serving to safeguard radio receivers, voltmeters, ammeters, transformers, condensers, and similar equipment against voltage surges, they also can be used to test ordinary fuses, defective resistors, or faulty condensers. In each case the excessive voltage is shunted through the fuse.

Soldering-Iron Sheath

IF YOU do your radio experimenting at a kitchen table and must store your soldering iron when you are not using it, the inexpensive heatproof sheath illustrated below will form a valuable addition to your tool kit. With it, there is no need to wait for the the iron to cool. Even the hottest iron, pushed into its asbestos-lined interior, can be stowed away without fear of fire. As an added advantage, the holder also is equipped with two collapsible rests that serve as a stand for the iron when it is in use. Because of its heatproof qualities, the sheath also can be used to bring an iron up to a high temperature quickly by allowing it to remain in place several minutes after the current is on.

New soldering-iron sheath in use, showing how the hot iron is put in it

Tool Strips Insulation

TO SIMPLIFY the problem of skinning the covering from long sections of wire, a new inexpensive insulation stripper has been developed. Suitable for all common sizes of wire, it consists of a U-shaped piece of spring steel bent in at the ends to form two overlapping jaws. A razor-edge V-cut in each jaw serves to cut through the insulation, allowing it to be pulled free. To strip insulation, all that is necessary is to place the wire between the jaws, close them, and pull.

Question: When were eyeglasses first invented? E. H., Omaha, Neb.

Here's the Answer

A.—ALTHOUGH the earliest mention of the magnifying power of shaped glass appears in a book published in the eleventh century, ancient literature tells us that the near-sighted Nero held a concave emerald to his eye when watching combats in the arena.

Once Is Usually Enough

Q.—IS IT true that a bee can sting only once, dying afterwards?—J. O. S., Alexandria, Va.

A.—NO. BY experimenting with all sorts of victims, an English scientist discovered recently that bees often sting several times, carefully removing the stinger each time for future use. It is only when the bee is careless and the victim violent, that the stinger is torn from the bee's body and left in the wound.

Dynamite's Kick

Q.—IN TERMS of pounds of blasted rock per pound of explosive, what is the blasting capacity of dynamite?—H. J.K., Buffalo, N.Y.

A.—AN EXPERT quarryman placing a two-stick charge of dynamite, weighing approximately one pound, in solid rock generally is satisfied if four tons of broken stone are thrown loose. In earth, one pound of dynamite can be expected to throw out about one cubic yard of dirt.

When Is A Color?

Q.—DO COLORS exist in the dark, even if we cannot see them?—R. F. A., St. Paul, Minn.

A.—ALTHOUGH color, as we know it, is a sensation caused by reflected light ot various wave lengths, our eyes are sensitive only to a limited range of frequencies. In a space which appears dark to the eyes, there may, and do, exist many radiations outside of this limited range. In this sense, color may be said to exist in the dark even though we do not see it.

Good Thing Air Is Free

R. B., BALTIMORE, MD. Approximately twelve pounds of air are needed to burn one pound of coal.

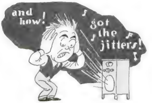
Poison Ivy's Poison

S. A. W., SALT LAKE CITY, UTAH. Urushiol, a distant cousin of carbolic acid, has been identified as the poison in poison ivy. In making this recent discovery, more than 800 tons of poison ivy leaves were used.

Blood and Life

Q.—DOES the blood die when the heart stops?—P. S., Cincinnati, Ohio.

A.—TESTS have shown that the blood remains alive and germ-free for at least eight hours after death. As a matter of fact, blood is now collected, graded, and preserved for future use in transfusions.



The Loudspeakers May

Q.—ARE scientists quite sure that the thousands of radio waves in the air have no effect on the human body?—T. Y., Tucson, Ariz.

A.—ALTHOUGH blaring loudspeakers may make us a race of nervous wrecks, it is doubtful if the radio waves themselves will have any ill effect on our bodies. So far, the only influence of radio waves that has been noticed is their ability to raise internal body temperatures. Fortunately, the human body can stand hundreds of times as much internal heat as that produced by even the strongest broadcasting station.

Densest Water

H. G. B., DETROIT, MICH. Ordinary water reaches its greatest density at about forty degrees Fahrenheit.

A Matter of Smell

Q.—WHAT is a vinegarroon and how did it get its name?—W. B. K., Medford, Okla.

A.—BECAUSE of the vinegarlike odor it emits when frightened, a species of whip scorpion has been given the nickname of "vinegarroon." The best known vinegarroon is a Mexican variety said to be extremely poisonous.

Maybe It's the Spring

Q.—ON THE average, do the seasons of the year have any effect on the growth of children?—J. W. A., Atlanta, Ga.

A.—AS THE result of a survey made in Europe, it is believed that children grow more rapidly during April, May, and June than during any other period in the year.

Getting Into the Air

E. C., RAMONA, CALIF. Normally, an ordinary land plane must run several hundred feet before it takes off, often reaching a speed of a hundred miles an hour. The autogiro can take off in less than ninety feet at a speed as low as twenty-five miles an hour.

Radio-Minded America

L. O. D., NEW YORK, N. Y. According to one estimate, approximately 19,000,000 homes in the United States are equipped with radio, almost one third of this number having more than one set.

Rubber Tree Shoots Seeds

Q.—IS IT true that the rubber tree sometimes makes a rapid-fire noise like the continuous popping of a machine gun?—G. W. H., East Orange, N. J.

A.—YES. The seed pods of the rubber tree contain a gas which causes them to explode, shooting the ripened seeds seventy-five to one hundred feet out into space. This is nature's method of spacing the trees. Because of these explosions, a rubber-tree plantation often sounds like a shooting gallery.

Gasping Just A Thirst

Q.—WHY do we gasp or breathe quickly after exertion or when we are startled?—E. A. M., Kansas City, Mo.

A.—WHEN we run or work, carbon dioxide piles up in our blood. We automatically breathe faster to dilute it. The same thing happens when we are startled. Being surprised or frightened, we forget momentarily to breathe and the carbon dioxide accumulates to a point where we must gasp to dilute it.

Race of the Century

E. W. B., PROVIDENCE, R. I. The cheetah, or hunting leopard, and the antelope share the speed honors in the animal kingdom. The top speed of a fast antelope for short distances has been estimated as sixty miles an hour.

Good News for Fat Men

R. B., BOSTON, MASS. According to a recent study made of a group of English aviation students, overweight young men have, on the average, more *(Continued on page 122)*

For a moment the car **spurted ahead.** Then, **suddenly,** it **lost** its **speed. "That's** always **the way," said** Withers

When Your Motor Misses

By **MARTIN BUNN**

WITH a clear road ahead, Cy Withers nosed his car out from behind a large bus and stepped on the gas. For a moment, the car spurted ahead. Then, suddenly, as if bucking a strong wind, it hesitated and lost speed. Withers turned to Gus Wilson, who was riding beside him.

"Now, do you see what I mean?" he grumbled. "That's always the way. At low speeds, she's swell, but as soon as I step on it to pass something, she dies on her feet."

Gus rubbed the stubble on his chin thoughtfully. "Let's try it again," he suggested. "Only don't step on it so hard, and when she begins to lose speed, let up on the accelerator for a second or so."

Withers nosed out of line for another try. This time, by feeding the gas in spurts, he did manage to pass the bus, but only after a tight squeeze with a loaded truck going in the opposite direction.

"Phew!" exclaimed Gus, nervously. "A little better, but none too good at that. Suppose you pull over to the side of the road, and we'll take a look under the hood."

"Could the spark plugs have anything to do with it?" Withers put in a few minutes later, as Gus ran his skilled fingers over the various rods and pipes that sprouted from the carburetor.

"They could, but I've got a hunch it's something else this time. There's a heap of things besides spark plugs that can make a motor miss." Working as he talked, the veteran mechanic went over the motor from stem to stern. Everything from the distributor to the vacuum tank came in for its share of attention.

"New heater?" he asked suddenly, patting two hose connections that led through the cowl wall.

Withers nodded. "Put it in myself about three months ago," he declared proudly.

"Well, you made a fine job of the heater, but you certainly messed up the vacuum tank."

"Messed up the vacuum tank?" Withers echoed, peering over Gus's broad shoulders. "I never even touched it."

"Maybe not," Gus replied. "But you sure put a swell kink in this pipe that runs from your intake manifold to the top of the vacuum tank. Got a roll of tire tape in your tool kit?"

After several minutes of rummaging, Withers emerged holding a small black roll. Gus stripped off several feet and proceeded to wrap it around the sharp bend in the small pipe. "There," he grunted, pressing the end of the tape in place. "Now suppose we try her again and see what happens."

Much to Withers' surprise, the car seemed peppier as it gained speed. At forty miles an hour, the motor still ran smoothly, and as the speedometer climbed to forty-five and then on to fifty, a broad, satisfied grin beamed across Gus Wilson's face.

GUS says:

Using your clutch pedal as a foot rest when you're driving is bad business. It puts a heap of extra wear on the clutch. The friction surfaces that act as the connecting link between your motor and rear end have enough to do without giving them extra wear unnecessarily. And that goes for the trick of holding your clutch down while you're waiting for the light to change too.

"Well, that sure turned the trick," agreed Withers as the two men started the trip back to the Model Garage. "But I still don't see why bandaging that pipe made so much difference."

"Ever try to suck water through a leaky straw?" asked Gus. "That's what your motor was trying to do, only the leaky straw was the manifold suction pipe that puts the vacuum in your vacuum tank, and the water was gasoline. When you tried to make room for those heater connections, you must have bent the suction pipe and cracked it. Naturally, air leaked in, spoiled the suction, and cut down the vacuum in the vacuum tank.

"At low speed, the leak didn't make much difference. The intake manifold developed plenty of suction, and the motor didn't need much gas. At high speed, though, it was different. Your motor needed plenty of gas, the manifold suction was less, and the leak cut down the suction just enough so that the supply of gas in the vacuum tank couldn't keep up with the demand."

By this time, the car had reached the Model Garage, and Gus directed Withers into the repair shop.

"You know," Gus mused, as he started to work putting in a new length of pipe, "It's a funny thing about this garage business. Jobs seem to run in bunches. This is the third gas-feed job I've had this week, and the second one that's had something to do with the vacuum tank.

"Monday morning, a fellow came in here all in a huff. Seems he'd been having trouble with his vacuum tank. Around the city, it was fine. *(Continued on page 122)*

MAKING

Colorful Modern Rings

FROM OLD

TOOTHBRUSH HANDLES

Five typical rings made by the author from scraps of celluloid with a few tools that did not cost a dollar

By F. L. Nowosatka

MODERN-looking rings and other costume jewelry of unusual beauty can be made easily by hand from old toothbrush handles, combs, umbrella handles, women's hand-bag handles and clasps, bathroom soap boxes, toothbrush holders and boxes, celluloid buttons and belt buckles, or any other such articles.

If discarded materials are not at hand, a supply can be obtained at any five-and-ten-cent store, or scrap celluloid in various thicknesses and countless color combinations may be bought by the pound from dealers and manufacturers. It is known under many trade names, usually ending in "oid," "ine," or "ite," but the term "celluloid" is loosely applied to this entire group of synthetic plastics. They all have the same general characteristics, being hard, light in weight, tough but elastic, and moderate in cost.

Heated to the boiling point of water, celluloid becomes flexible. It can be turned, carved, or ground; polished, bent, and pressed; stamped, molded, or blown. It is, indeed, one of the most convenient plastics to work with. Only the fact that it is inflammable can be regarded as unfavorable.

Now, if you have found an old toothbrush handle of appropriate color, let's try to put it around your finger as an ornamental—and decidely unique—ring. You can create your own design as you go along, so do not feel that you must follow directions slavishly. The author has made and sold hundreds of rings, but rarely two alike.

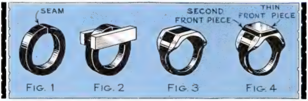
For a man's ring, cut the handle 3 in. long; for a lady's ring, 2½ in. long. Place the piece in a small vise and file the oval-shaped edges flat and even on both top and bottom; then file both sides smooth. Soften the handle in a pan of boiling water for five minutes, and bring the two ends together under water as in Fig. 1 with slender-pointed pliers or tweezers. Remove from the water and seal the seam at the ends with several drops of acetone put on with an eye dropper. Let it stand for half an hour until the acetone welds the ends together.

Take another toothbrush handle of a harmonizing or contrasting shade, file down the rounded edges, tops and bottoms until smooth, and cut two pieces about 1 in. long, ⅜ in. wide, and ¼ in. thick. File all sides to a smooth surface and seal the pieces onto the ring (shank) with acetone as in Fig. 2. Let stand for one hour, then shave off any protruding edges on the top and sides with a fine-bladed coping saw, as illustrated in Fig. 3. Use a smooth file to finish the sawed parts to the shape desired and to complete smoothness.

A strip of thin celluloid may be put on the front of the ring, if desired, as shown in Fig. 4, and another layer of contrasting color on top of the first front piece, giving a two-toned top. File this top down after the acetone has taken effect and dried. Finish all edges and sides in any way preferred—square, oblong, oval, or octagonal.

After the ring (Continued on page 96)

The toothbrush handle is cut off, filed flat and square, softened in boiling water, bent round, and cemented at the joint with acetone



Method of making a ring from a strip of celluloid with thinner pieces added. The seam is kept in front so that it can hardly be detected. Endless designs may be worked out in this manner

KEEPING TABS ON THE WEATHER

THERE'S a hobby for you! It is endlessly fascinating, does not take much time or attention, costs little, requires no great mechanical skill or scientific ability, has lots of variety, forms a good subject for conversation, serves a useful purpose, and grows steadily more interesting through the years. Where can you match that combination?

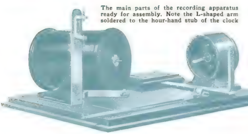
Many readers are already aware of this. When we published an announcement in the January issue headed "Set up a Little Weather Bureau of Your Own," the response was immediate . . . and amazing. Letters and post cards by the hundreds poured in and are continuing to do so.

What do you need to start this hobby? Nothing more than a thermometer, barometer, and hygrometer of unquestioned accuracy. These instruments must be good, the product of a manufacturer of absolute reliability. In addition, if you like to make things yourself, you can construct various supplementary instruments and equipment. Weather maps can easily be obtained; in fact, they are published daily in some of the larger newspapers. Books on how to use the instruments and how to read the clouds and other natural weather indicators are available everywhere.

We cannot answer individually all the letters received, but we will publish articles on the various subjects suggested in the order of their importance. Here are two typical letters:

It gave me a thrill to discover in your January issue the article on "Making a Wind Gauge." I have been looking for this material for some time and up to now have been unable to find anything simple enough. For the past three years I have had a U. S. Government coöperative weather station, furnishing my own instruments. I am therefore much interested in this as a hobby, and am starting right away on this anemometer.—I. M. W., Versailles, Mo.

I would like to have an article on how to make a maximum and minimum thermometer, and would it be too much if I requested you to print articles on a mercury barometer, a hygrometer, and a seismograph? I have a homemade anemometer of the revolving type that flashes a light every twelve revolutions. My outfit also includes an aneroid barometer by the leading American maker. I might add that I have been a subscriber to Popular Science for about twenty years.—H. S. M., Bangor, Me.



The main parts of the recording apparatus ready for assembly. Note the L-shaped arm soldered to the hour-hand stub of the clock

EDWIN M. LOVE

Recording

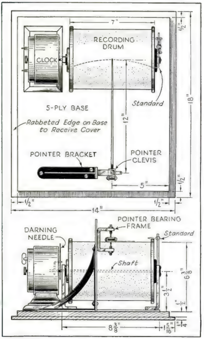
ACCORDING to the old adage, a watched kettle never boils. On the other hand, an unwatched kettle not only boils, but generally foams over and often spoils the cooking. In the same way the amateur weather observer often finds that his anemometer is becalmed and registers zero during his leisure hours, when observation is possible, and cavorts in entertaining gales during working or sleeping time. Consequently a recording drum is desirable, as it not only charts the behavior of the wind continuously over a period of hours, but offers a means of comparing records from day to day and year to year.

The recording apparatus illustrated was designed for the anemometer described in a previous issue (P.S.M., Jan. '35, p. 64). Once the principle of construction is understood, any reasonably ingenious mechanic can adapt the design to suit almost any type of meteorological or other apparatus he wishes to equip with a recording drum. The cost of materials is nominal. What are mainly required are patience and careful workmanship. With these, anyone can make a drum that will give a record sufficiently accurate for most amateur scientific work.

Base. Use well-painted plywood.

Drum. Saw out two three-ply disks and two rings. Mount 1-in. block on faceplate; turn and face it; screw end disks to it for turning. Glue and brad rings to disks. Turn profiles as detailed, with accurate center holes. Paint the insides.

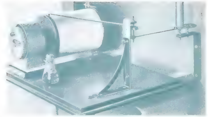
Turn wooden mandrel. Drive on drum ends. Center



TELLS HOW TO MAKE A LOW-COST

Drum *for Weather Instruments*

It will keep a never-sleeping eye on your wind gauge . . . Can be adapted to other uses



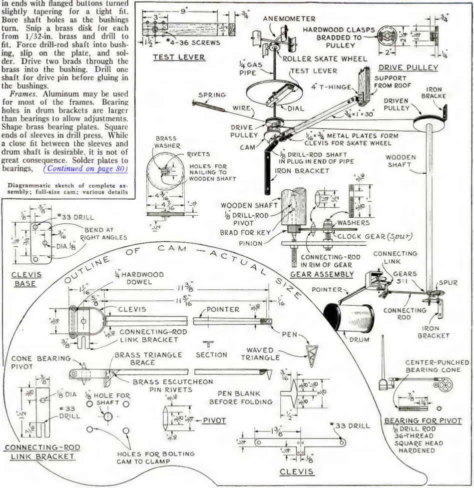
As the anemometer turns, its motion is transmitted down, as illustrated in the perspective drawing below, and causes the pen to trace a zigzag record

mandrel again in lathe. Rip twenty-six pine strips 1/8 by 5/8 in., 6½ in. long. Tack four temporarily to sheathing rings 90 deg. apart. See that drum ends are square with mandrel. Glue on all strips at ends and edges, removing temporary braces as they are reached. Bind with string at each end. Fill joints with glue and sawdust.

When dry, turn and sand drum round and to accurate circumference of 16 in. After painting, smooth again and test for size. Bush holes in ends with flanged buttons turned slightly tapering for a tight fit. Bore shaft holes as the bushings turn. Snip a brass disk for each from 1/32-in. brass and drill to fit. Force drill-rod shaft into bushing, slip on the plate, and solder. Drive two brads through the brass into the bushing. Drill one shaft for drive pin before gluing in the bushings.

Frames. Aluminum may be used for most of the frames. Bearing holes in drum brackets are larger than bearings to allow adjustments. Shape brass bearing plates. Square ends of sleeves in drill press. While a close fit between the sleeves and drum shaft is desirable, it is not of great consequence. Solder plates to bearings,

(Continued on page 80)

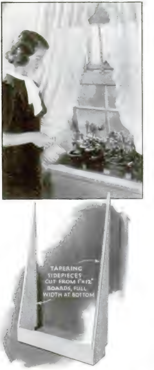


Diagrammatic sketch of complete assembly; full-size cam; various details

STORM SASH SERVES AS
Window Greenhouse

IF FITTED with a storm sash, any window, but preferably one with a southern exposure, may be converted into a miniature greenhouse. One by twelve inch boards form the sides and bottom of the house, while the storm sash, tilted out at the bottom, completes the inclosure.

The room within is not obstructed, and the plants may be readily watered through the window. By leaving the window open a little top and bottom in severe weather, damage from freezing is prevented. With the window closed, a high degree of humidity is maintained, which, with the good daylight afforded, gives ideal conditions for plant growth.—W. DeR. CHRISTIE.

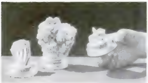


The framework against which the storm sash rests and, above, the greenhouse from inside

HOW TO MOUNT MINERAL SPECIMENS ON GLASS

ORDINARY glass furniture cups, sold for use as casters in hardware and five-and-ten-cent stores, make attractive and inexpensive bases for mounting mineral specimens. Plaster of Paris should be poured into the cup until nearly full, and the mineral or other specimen pressed into the plaster and supported until the plaster sets and holds it permanently in position.

If desired, a label bearing the specimen name and other data may be glued to the front of the glass base.—L. C. PELTIER.



Swinging Shop Signs
THAT CATCH THE EYE

Mar 1935

Ingenious Three-in-One Table

FOLDS UP FOR SERVING BREAKFAST IN BED

By Charles M. Rice

UNUSUAL in design and light and compact in construction, this combination table can be converted instantly from a bedside stand into a bed table, and it may also be used outside the bedroom when desired as a tea or coffee table. It should therefore find ready use in any home.

A careful study of the illustrations will reveal that this unique piece of furniture, far from being as complicated as it looks, is really easy to make. All parts may be fashioned by hand if necessary, although a small power shaper can be used to advantage for molding the edges of the top and legs. The design of the legs could be modified in various ways; likewise, a more interesting form might be given to the rungs if it is possible to turn them on a lathe.

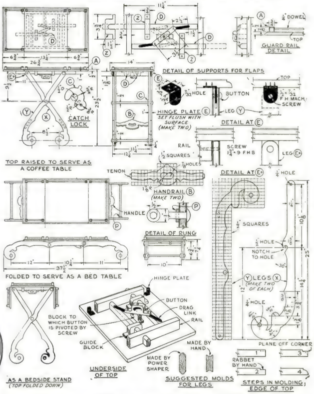
The stock used for the top, legs, and handrails is ½-in. five-ply wood, with hard wood on two sides. The patterns should be worked out carefully before construction work is started to assure the best results and avoid waste of materials. It will be noted that the legs are made in pairs, one pair having a plain hole in each leg at the center, while in the other pair, the hole in each leg is notched to the edge as shown in the photograph below.

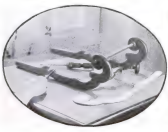
Buttonmolds may be used to cover the raw ends of the rungs if no lathe is available. The hinges and hinge plates should be set flush with the lower surface of the top. The safety catch, which hooks under the center rung, is very important for keeping the table rigid when in an upright position.

When the table is ready for the finish, one set of legs may be detached in order to get at the surfaces more readily. The finish may vary according to individual taste and the character of the materials used.

The completed table should be kept in an accessible place so that it can be conveniently picked up and carried where needed. Perhaps its best permanent use is as a bedside stand. When needed for a bed table, it is then necessary only to release the safety catch and lower the stand to a horizontal position by grasping the two handrails. When a coffee or tea table is needed and the table is again in its vertical position, reach down and turn the button beneath the top. This pushes out supports *D*, the slightly rounded ends of which cause the end flaps to rise.

When the two end flaps are raised, the table may be used for serving tea or coffee. To convert it into a bed table as shown at the left, a safety catch is released and the top lowered



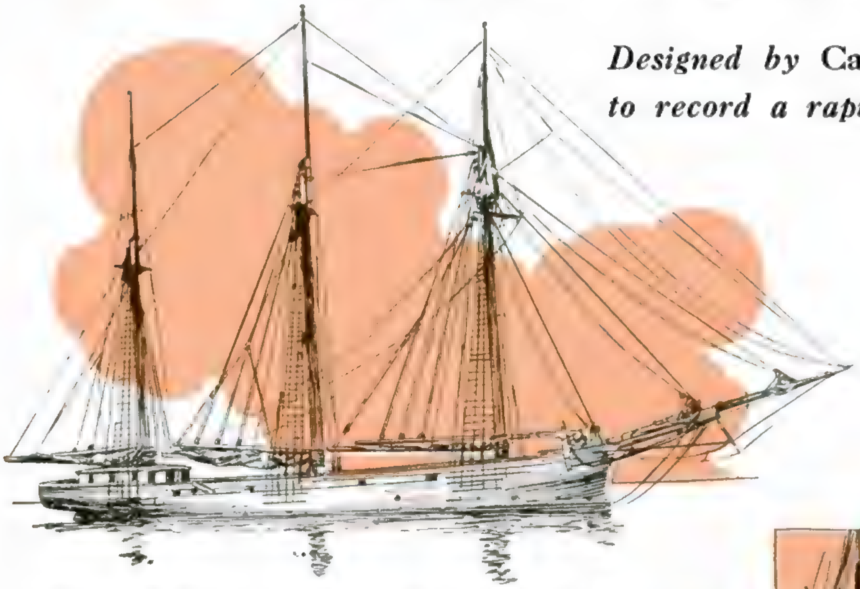


The assembled table as used for a coffee table, a bed table, and a bedside stand; details of the parts, and a sketch of the flap-raising mechanism. *At left:* The legs are made in pairs

COMPLETE IN THIS ISSUE

A New Trading

Designed by **Captain E. Armitage McCann** *to record a rapidly vanishing type of vessel*



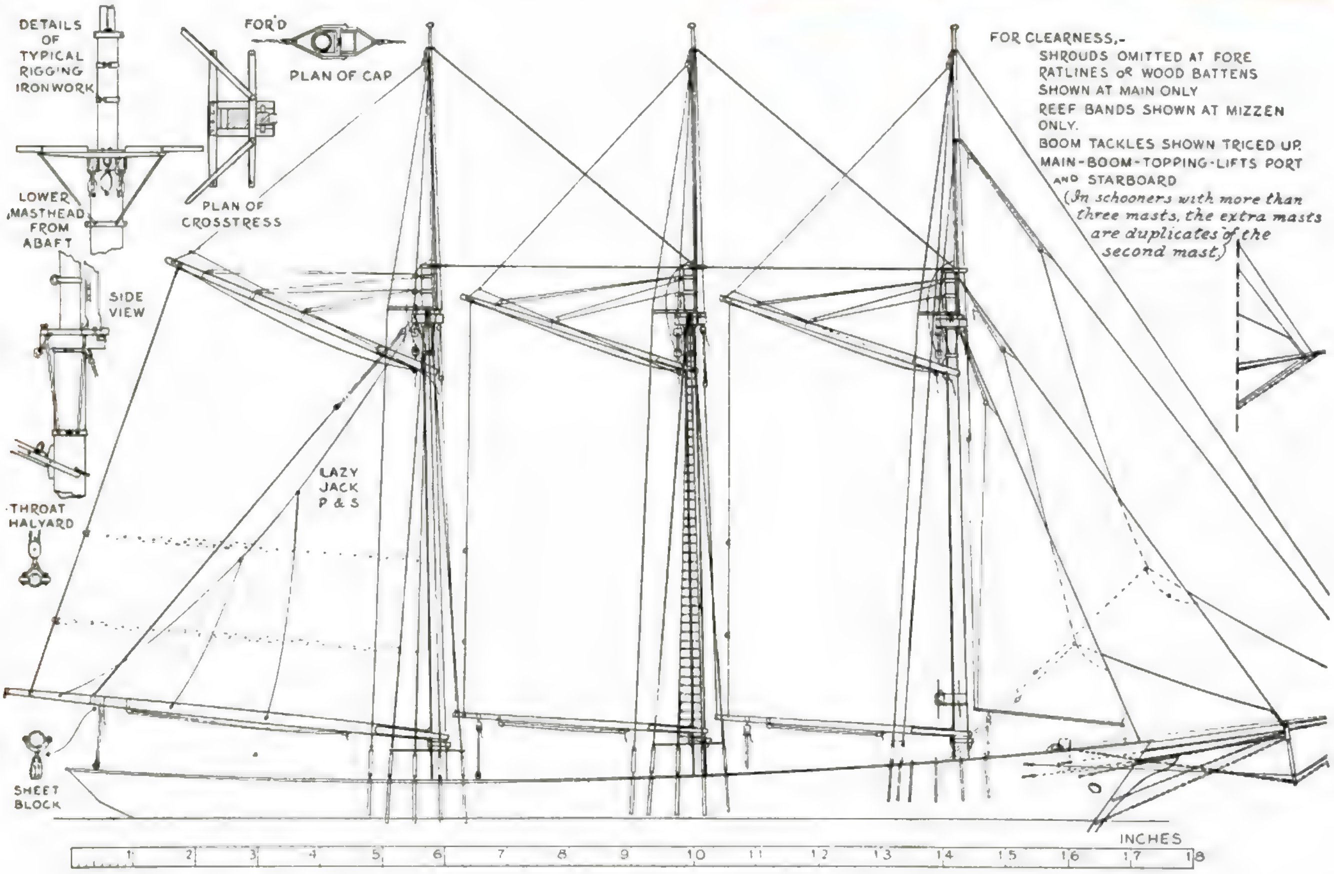
These two sketches, another on the facing page, and a fourth on page 107 were made from photos of the *L. A. Simpson* to show a typical Great Lakes schooner

IN RESPONSE to many requests for a trading schooner model, we are illustrating, complete in this issue, the lines, sail plan, and some details for a vessel of that kind.

There are, of course, various schooner-rigged vessels, which may be roughly classified as schooner yachts, fishing schooners, and trading schooners. Of these, each one varies from the other. They may be large or small and have from two to, in one instance, seven masts. Some have sails only, others are fitted with auxiliary engines.

In build, certain schooners have flush decks (on one level) fore and aft, with or without deck houses; some have a poop, forecastle, and main deck; others, as in our plan, have a long quarter-deck and well-deck forward, with skylights and all accommodations below.

Schooners are built differently in various parts of the country. The West Coast, Great Lakes, and "Down East" have their own general characteristics. Some are heavily built with clipper bows and stern, heavy catheads, and resemble clipper ships except for the sail plan. The West Coast appear to be, on the average, the largest and heaviest, the Great Lakes schooners next, and the East Coast smallest. These factors are, of course, governed by the



FOR CLEARNESS,-
SHROUDS OMITTED AT FORE
RATLINES OR WOOD BATTENS SHOWN AT MAIN ONLY
REEF BANDS SHOWN AT MIZZEN ONLY.
BOOM TACKLES SHOWN TRICED UP.
MAIN-BOOM-TOPPING-LIFTS PORT AND STARBOARD
(In schooners with more than three masts, the extra masts are duplicates of the second mast.)

Schooner Model

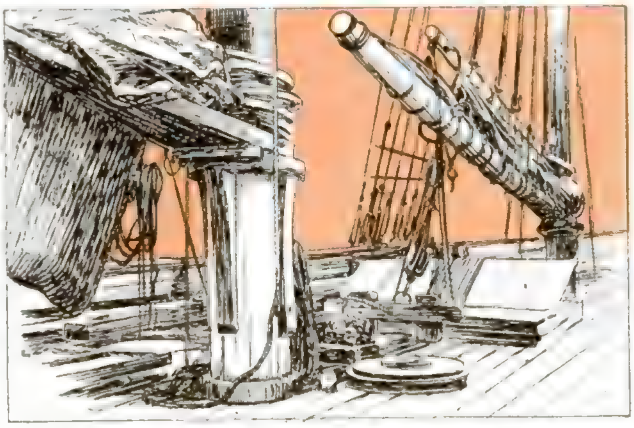
cargoes they are intended to carry—lumber, iron ore, cement, bricks, or coal.

Our schooner is of the Maine type. More schooners, but not the largest, have been built at Maine ports than elsewhere, yet they are becoming scarce because of the difficulty of finding cargoes for them. They can carry goods more cheaply than the steamers, but are not so certain in their date of delivery. The last little boom they had was carrying lumber from the West Coast to Florida during the building boom. The *Lyman M. Davis*, said to be the last of the Lake schooners, has recently been broken up.

Other countries have been less inclined to favor this type of coaster, preferring topsail schooners, brigs, and the like. Here, however, there have been great fleets of them, particularly on the East Coast, carrying passengers and every conceivable kind of cargo in and out of all ports, large and small.

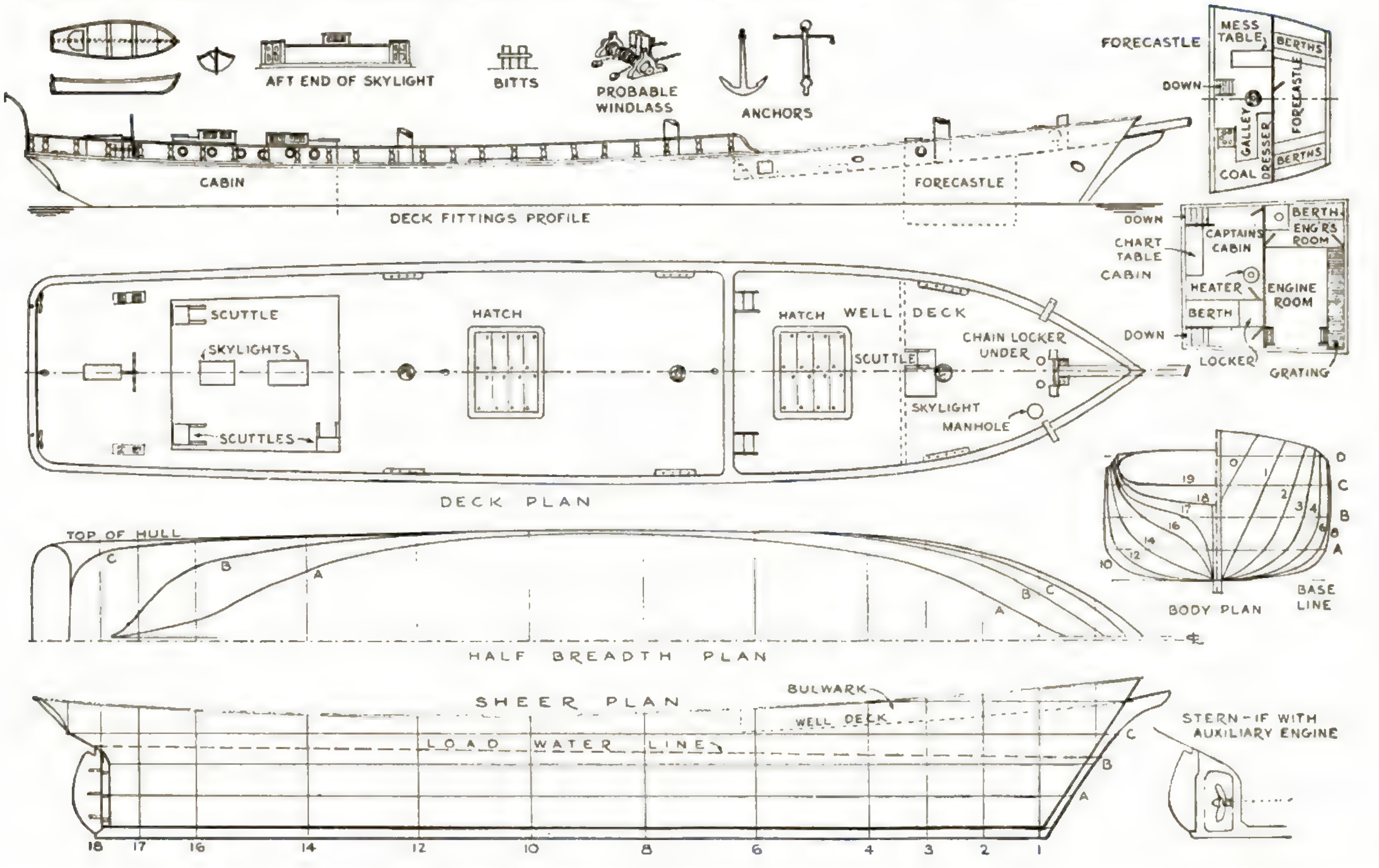
Trading schooners vary in size from under 100 ft. in length to 395 ft in the case of the *T. W. Lawson.* The favorite size was from 150 to 200 ft. We have chosen one 128 ft. long by 28 ft. beam, because a great many of about this size have been built. Such a length makes a good-sized model for building on the scale of 1/8 in. equals 1 ft. Three masts are the usual rig for a vessel of this length.

Any reader who has not previously made a hull of this general type can build it by following the instructions for various models previously described in POPULAR SCIENCE MONTHLY. (See especially "How I Build Ship Model Hulls on the Bread-and-Butter Plan," P. S. M., Oct. '33, p. 68.) Half-inch lifts, or water lines, are shown, but any other thickness can be used by redrafting the half-breadth plan from the body plan.



Deck view on board the *L. A. Simpson.* Our model differs to some extent in design, but try to make the details look as real

I suggest making the hull right up to the top line of the sheer plan and then cutting down the well deck and fitting the bulwarks. It would perhaps make an even better-looking hull if one left it flush fore-and aft, with a rail, as aft, right around, and raised the forward skylight and other fittings to that level, but with the bowsprit, of course, below the deck, and the hawse pipes lengthened. The windlass is as shown on the designer's plans, but I believe the model should have a more efficient windlass, *(Continued on page 107)*



The plans above and on the facing page are for a model of a Maine type schooner about 22½ in. long over all. Use the inch scale for finding dimensions

FRANKLIN H. GOTTSHALL designs a

Chippendale Stool

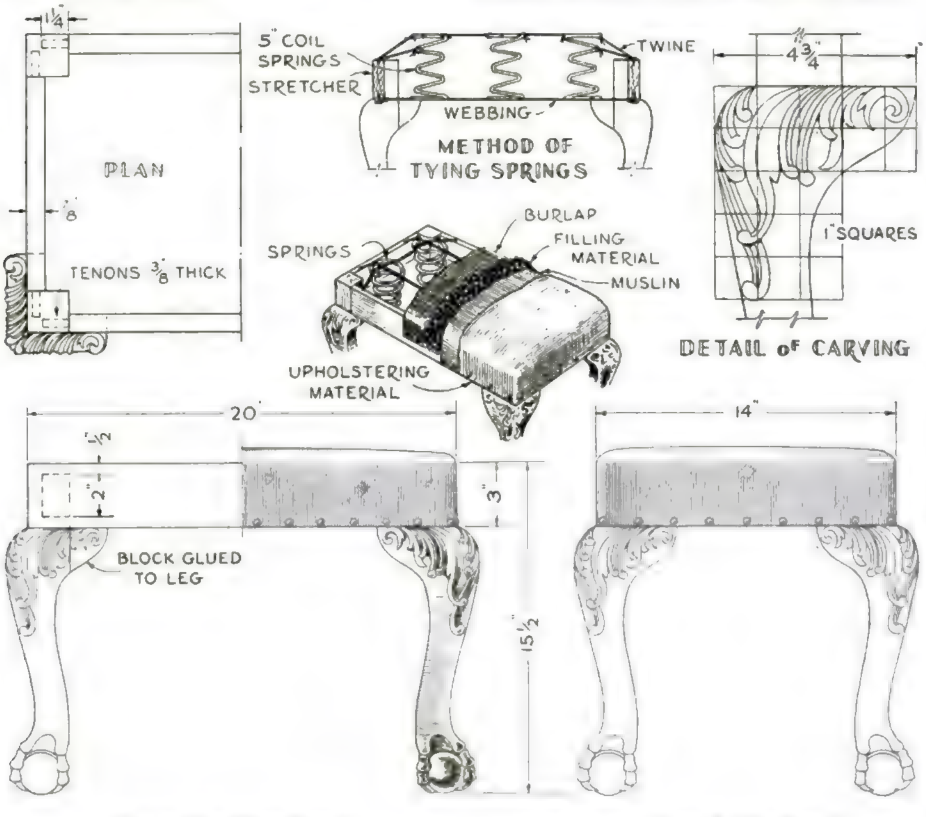
FOR YOUR LIVING ROOM

By making this graceful stool, the amateur can practice both carving and upholstering without spending much for materials

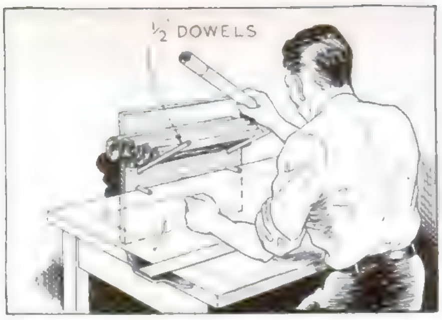
DESIGNED in Chippendale style, this stool is graceful enough to be used in a richly furnished living room. It will serve as a comfortable seat, but is especially intended to be placed in front of a wing chair, such as the one described in a previous article (P. S. M., Dec. '34, p. 68).

Use mahogany for the legs, but the stretchers may be made of hard pine.

To upholster the stool, tack webbing to the bottom of the seat frame. Two strips lengthwise and three crosswise will suffice. Sew six 5-in. springs to the webbing where it is crossed, and tie these to the frame as shown. The springs should not be compressed by the tying. After the springs have been tied, cover them with a good grade of burlap to prevent the filling material from going through the seat. Spread the filling material (either curled hair or moss) evenly in a layer about 2 in. thick, allowing it to hang over the sides as shown. Sew a few stitches through the filling material into the burlap to help hold it in place. Next cover the filling material with muslin, tacking it as shown. A layer of cotton felt may be placed under the muslin, on top of the seat, if desired. This will help to make the seat smoother. Finally cover the seat with the upholstering material, tacking it with brass-headed upholstering nails.

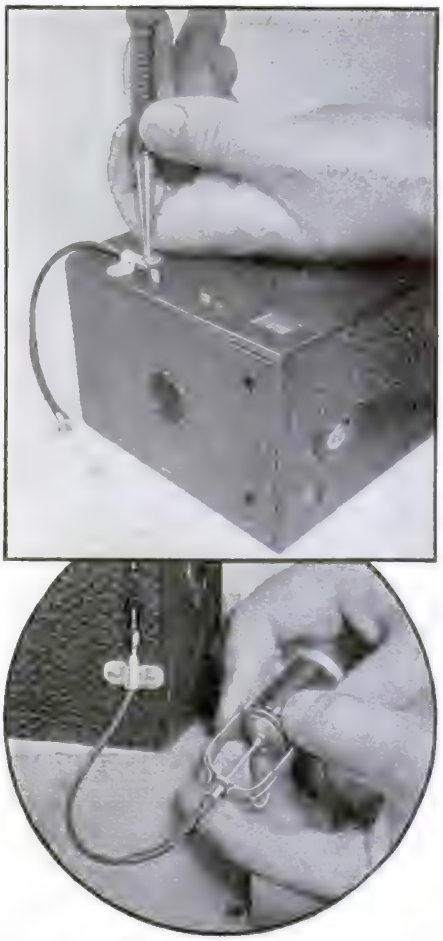


Drawings of the assembled stool, how to lay out the carving, and method of tying the springs and applying the upholstery. The legs are mahogany, but the rails may be a less costly wood



RACK TO HOLD DRAWINGS

DRAFTSMEN often have to work in temporary quarters where there is no convenient place for rolled-up blueprints, detail sketches, and other reference material. A rack for this purpose can be made in a few minutes as shown above.—J.D.G.



FITTING A SELF-TIMER TO A BOX CAMERA

EVEN if you have only a box camera, you can attach a standard self-timer to it as shown above and thus be able to get into a group photograph yourself. Besides the timer, you will need a cable shutter release. Mount the cable release as shown with a small bracket of thin aluminum or other suitable sheet metal. This is riveted directly under the box-camera shutter release. The self-timer is slipped on the other end of the cable release.

Each time this device is to be used, the shutter trigger must be in the "down" position. If it is in the "up" position, set it while holding a hand over the lens so that no light can enter as the shutter opens.—GEORGE S. GREENE.

Official Magazine
POPULAR SCIENCE MONTHLY

Members of the St. Joseph Homeworkshop Club of St. Joseph, Mo. It started with fifteen members last October and now has grown to forty

Last Call for the GREAT $2,000 GUILD CONTEST

Home Workshop Clubs Push Final Preparations for National Handicraft Exhibition in March

LIGHTS are burning late in the home workshops of hundreds of members of the National Homeworkshop Guild as they put into shape their entries for the first National Exhibition and Contest to be held in Chicago, March 25 to 30. They are spurred on by the hope of winning one of the thirty-eight prizes—$2,000 in cash and ten silver cups and trophies—either for themselves or for their local clubs.

The contest is going to be much larger than even the officers of the Guild anticipated when it was first announced in the August, 1934, issue of POPULAR SCIENCE MONTHLY. For one thing, the Guild has grown rapidly since then. At that time there were ninety-six clubs, which was regarded as a large number and a remarkable record to be established in about eight months. Now, however, there are 135 clubs.

Another factor, of course, is the liberality of the prizes. The dues paid to the National Homeworkshop Guild by its affiliates are nominal and hardly do more than cover postage and clerical bills, with nothing left for the expenses of a national exhibition, not to speak of prizes. A number of sponsors came forward, however, and are contributing prizes for nine divisions of the contest. POPULAR SCIENCE MONTHLY is donating the grand sweepstake prize and also bearing the administrative expenses of the show. Not one cent therefore is to be taxed against the local clubs for this great event, and there will be no entry fees.

Some local club members are also putting special effort into this show because they realize that their work will be better displayed, and they will also have a better chance to win a prize, in this first exhibition than in any future one. As the Guild grows, competition will become stiffer and there will be more entries. There is rarely a contest of any kind, and certainly no national contest, in which the number of prizes is so large in proportion to the probable number of entries. In short, everyone's chances of winning are good, and, win or lose, club members know that their exhibits will be well displayed and viewed by large crowds of men who appreciate good craftsmanship.

Silver trophy to be awarded with $100 for the best furniture made with power-driven tools

How many entries there will be cannot be estimated at this time because only a few clubs have definitely reported the number they ex-

(Continued on page 88)

The CONTEST *at a* GLANCE

Time and Place—March 25 to 30 in Chicago, Ill. An entire floor of the building at 211 East North Water Street has been turned over to the Guild for this purpose through the courtesy of Hibbard, Spencer, Bartlett & Co.

Who Are Eligible—Clubs affiliated with the National Homeworkshop Guild and their members.

Purpose—To bring together typical examples of amateur craftsmanship from all parts of the United States in a friendly competition, with prizes as follows:

Division	For	Prizes 1st	2nd	3rd	Sponsor
1 Club woodworking	Clubs	Cup and $100	$65	$35	Stanley Tools, Hand and Electric Tools, New Britain, Conn.
2 Civic activities of clubs	Clubs	Cup and $100	$65	$35	Millers Falls Company, Greenfield, Mass.
3 Furniture made with hand tools	Individuals	Cup and $100	$65	$35	E. C. Atkins and Company, Indianapolis, Ind.
4 Furniture made with power tools	Individuals	Cup and $100	$65	$35	The Delta Manufacturing Co., Milwaukee, Wisc.
5 Veneering and inlaying	Individuals	Cup and $100	$65	$35	The Casein Manufacturing Company of America, Inc., New York, N. Y.
6 Wood turning	Individuals	Cup and $100	$65	$35	Greenlee Tool Co., Division of Greenlee Bros. & Co., Rockford, Ill.
7 Novelties and toys	Individuals	Cup and $100	$65	$35	Henry Disston & Sons, Inc., Philadelphia, Pa.
8 Model making	Individuals	Cup and $100	$65	$35	Russia Cement Company, Gloucester, Mass.
9 Decorative metal work	Individuals	Cup and $100	$65	$35	The Carborundum Company, Niagara Falls, N. Y.
10 Grand sweepstake prize	Clubs	Cup and $200			Popular Science Monthly, New York, N. Y.

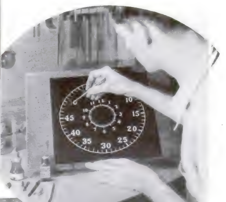
Child's play house given as prize by Elmhurst (Ill.) Homeworkshop Club at stage show to finance toy repair program

H*omemade* Darkroom Clock

HAS LARGE DIAL MARKED WITH LUMINOUS PAINT FOR READING AT A DISTANCE . . . WILL NOT FOG SUPERSENSITIVE FILMS

By *Dudley* W. *Read*

Because of the size of the dial and the arrangement of the hands, the clock can be read from any distance up to 5 ft. in total darkness. The longest hand indicates the seconds



HERE is a luminous darkroom clock that will not fog high-speed film, yet it can be read approximately 5 ft. away in complete darkness. It can be used for timing either film development or the exposure of enlargements or contact prints.

The only parts required for making it are an inexpensive electric clock, a sheet of black Bristol board, a bottle of luminous paint, several calendars from which to cut suitable figures, and a few miscellaneous items such as solder and a small piece of thin sheet aluminum. If a thin enough sheet of aluminum cannot easily be obtained, you may use a heavy candy wrapper of the aluminum-foil type. This will be heavy enough.

Cut the Bristol board 12 in. square. With a pair of dividers or compasses, draw two circles, one 10 in. in diameter, the other 3 in. Divide both these circles into sixty equal sections. Make ⅜-in. long marks for the seconds on the 10-in. circle; and for ease in reading, double the thickness of every fifth mark. On the 3-in. circle make the minute marks ¼ in. long, and every fifth mark ½ in. long, as shown. To paint them, use a draftsman's ruling pen filled with luminous paint between the nibs instead of ink.

Cut figures about 1 in. high from a calendar to read from 5 to 60. Also prepare another set of figures about ½ in. high to read from 1 to 12. Glue them in position on the dial and give them one heavy coat of luminous paint. This will make the figures stand out slightly in an embossed effect, and they will be much easier to read.

Remove the case from the clock and pull off the hands with a pair of pliers, Remove the face from the motor by filing off the rivet heads.

A frame 12 in. square is made and covered with a piece of plywood which has an opening to receive the clock motor

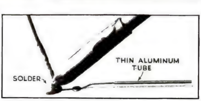
Make the extension for the second-hand out of the sheet aluminum. Roll one end to form a round tube, fill it with ceiling wax, and insert the second hand that came with the clock. Allow the wax to harden, then balance the second hand by adding solder on the short end till it will balance on a small nail. Give all three hands a coat of luminous paint.

Drill a hole in the center of the new face and three or four holes for bolting the motor to the face. Bolt it on with No. 6-32 machine screws. Construct a wooden frame 12 in. square and tack onto it a piece of plywood with an opening in the center for the clock motor. Glue the face to this piece of plywood, and put on the hands by pressing them carefully and accurately in place with the pliers.

Cut four pieces of wood ½ by ⅜ by 12 in. long, with the ends on a 45-deg. angle. On the ½-in. face of each strip, cut a saw slot 1/16 in. from the edge and wide enough to allow single strength glass to enter. Nail three strips on the face around the edge, cut a section of single strength glass 11¼ in. square, and slide it down the saw slots in the proper position. Then nail on the remaining strip. The frame and cover may be stained or painted in any way desired.

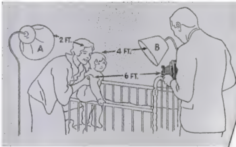
Hang the clock in some convenient place in the darkroom and plug it into an outlet.

IF YOU *entered our November, 1934, photo contest, turn to page 110 for a list of the prize winners.*



The second hand is extended by a tube of sheet aluminum filled with ceiling wax. It is then balanced with solder

Here's a snapshot you can make *Tonight*

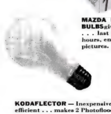


HERE'S ALL YOU HAVE TO DO

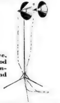
Use Kodak "SS" Film. Set your camera for 1/25 second. Open the lens to *f*.6.3. Put 1 Mazda Photoflood bulb in lamp A—2 in lamp B. Distances as indicated. Sight the subject, click the shutter—and you've made the picture.

ALL YOU NEED FOR SNAPSHOTS AT NIGHT

KODAK "SS"—the lightning-fast film, with the green lightning flashes on the familiar yellow box—the film that, indoors or out, in any light, improves picture quality.



MAZDA PHOTOFLOOD BULBS give brilliant light . . . last for about two hours, enough for many pictures. Cost but 25¢.



KODAFLECTOR — Inexpensive, efficient . . . makes 2 Photoflood bulbs do the work of 9. Complete with stand, reflectors and cord, $5.

HOW much happens after sundown that would make treasured pictures. Now you can get them—easily—as so many others are doing. You can take snapshots indoors, at NIGHT.

Just use any camera with an *f*.6.3 (or faster) lens, loaded with Kodak Super Sensitive Panchromatic Film. This high-speed "SS" Film is three times as fast as Verichrome, six times as fast as ordinary film, under artificial light. Two or three Mazda Photoflood bulbs give ample light.

Hold the camera in your hands as you would outdoors, set it for 1/25 second, open the lens to *f*.6.3. Sight the subject, click the shutter. You've made a snapshot. *Indoors . . . at* NIGHT.

KODAK VOLLENDA (*f*.3.5)

—a fine miniature camera. Takes sixteen 1 3/16x1 9/16 inch pictures on a roll of "vest pocket" film. Eight-speed Compur shutter . . . *f*.3.5 lens . . . eye-level finder. Ideal for snapshots at night. Price—$33.50.

ONLY EASTMAN MAKES THE KODAK

FREE . . . 32-PAGE BOOK

Here's a book you'll want in your library. Complete details about indoor pictures with Photoflood and Photoflash bulbs. Tells you how to make outdoor night pictures of lightning, lighted buildings, fireworks. How to make moonlight photos. Write to Eastman Kodak Company, Rochester, N. Y.

P.S. 3-35

Name____

Address______________________________________

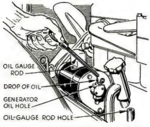
City____________________________ State____________

Helpful Hints *for* Your Car

Motor-Wise Readers Pass Along Some Handy Kinks They Have Worked Out

Handy Emergency Oiler

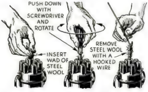
ALTHOUGH not recommended for regular use, a handy emergency oiler is present in every car fitted with an oil-level indicator rod. If you find that your generator, starter, or door hinges are in need of lubrication and you are minus an oil can, pull the oil rod from its hole in the crankcase wall. The drop that forms at its end can be applied in many places not readily accessible even with an oil can.—P. M.



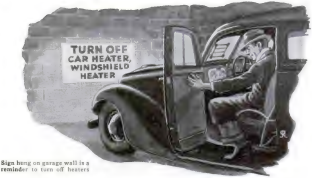
How oil gauge rod is used for emergency lubrication of generator, starter, and other parts

Cleaning Distributor Cap Terminals

BECAUSE it is hard to see and even harder to get at, the corrosion that forms inside the terminal caps at the top of the distributor can cause many ignition troubles. To remove this dirt and clean the metal surfaces, stuff a wad of steel wool into the hole and, pushing it down with a screw driver as far as it will go, turn it back and forth with a grinding motion. After several minutes, a hooked wire can be used to retrieve the wad. Incidentally, steel wool has many other uses around the garage. It is fine for cleaning valve stems and carburetor parts and can be used in many instances where the abrasive dust from either emery cloth or sandpaper might cause a great deal trouble.—W. G. L.



Drawing shows use of steel wool and screw driver to clean distributor cap terminals



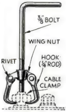
Sign hung on garage wall is a reminder to turn off heaters

Reminder Sign Saves Storage Battery

AS A check against forgetfulness, a large sign now hangs on the rear wall of my garage. Printed in bold black letters on a white background, it reads, "Turn Off Car Heater and Windshield Heater." I can't help seeing it when I drive in and heeding the warning has made forgotten switches a thing of the past.—P. A. E.

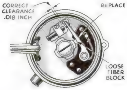
Cleaning Garage Floors

KEROSENE and ashes form an effective mixture for cleaning grease-spotted cement garage floors. When the surface dirt has been loosened with a shovel or hoe, sprinkle a cupful of kerosene on the floor, rubbing it into the spots with an old broom. Then work several shovelfuls of fine furnace ash into the kerosene and grease. After a good scrubbing, sweeping up the mess will leave the floors clean and white. Although with stubborn spots, a small amount of gasoline can be used, it must be applied sparingly and carefully, and only when the garage is well ventilated.—G. H. M.



Cable Clamp Puller

CORRODED cable clamps that stick fast to the battery terminals always are a source of trouble to both the garageman and the amateur mechanic. A convenient puller for these clamps can be made from a few scrap parts as shown in the illustration. All that is required is a length of threaded rod, a wing nut to fit, two short lengths of small-diameter rod, and a few rivets. Turning the center rod pulls the clamp loose, applying the pressure without marring either the clamp or the terminal.—E. P.

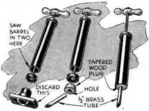


Cure for Hard Starting

HARD starting on small cars often can be traced to loosening of the rivets that hold the breaker arm fast to the fiber block in the distributor head. This allows the block to shift when hit by the cam and slows up the break; at cranking speed it is bound to cause trouble. Usually, the only lasting remedy is an entirely new breaker assembly.—E. T. G., Jr.

Homemade Grease Gun

IN AN old tire pump, you have the makings of a grease gun for your transmission or differential. Cut the barrel down to the desired length. Then, whittle a wooden plug to fit the pump barrel, drill it, insert a short length of brass tubing, and force it into place. The internal suction of the pump plunger will allow it to be filled with grease.—D. J.



Ford Materials and Methods

Mr. Henry Ford inspects a part of the history-making Ford V-8 engine. He insists on the finest materials and workmanship.

The quality of much of the steel used in Ford cars and trucks is controlled at its source—in the Ford steel mills.

THE most important material used in automobiles is steel; more steel is used than anything else. Ford uses thirty-six different kinds. Most people haven't any idea that there are so many steels, each with a different analysis. Some are low in carbon content, others high. Many contain elements—nickel, tungsten, chromium, molybdenum, vanadium—used to secure high physical properties.

The quality of much of the steel used in Ford cars and trucks is controlled at its source—in the Ford steel mills. Grades of steel are selected to provide high physical properties in all Ford parts. That's why they have high quality.

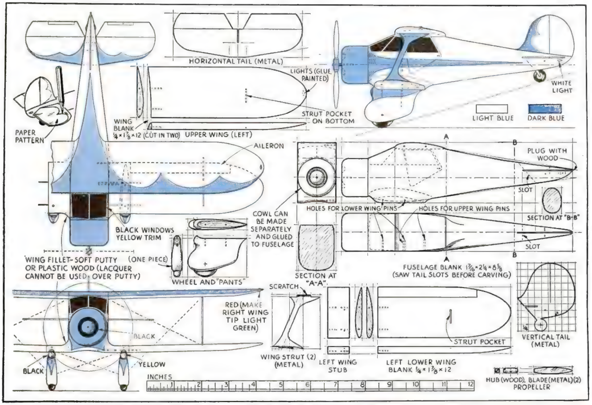
Skill in manufacture is important, not only in development and selection of material but in the production of parts. Ford uses many new and unusual methods of casting, machining and inspecting. Some were thought to be too scientific, too expensive to be used for producing automobile parts—until they were put into use in the Ford factory.

Precision has much to do with the quality of parts. The precision limits set for Ford parts established new high standards. Modern science is used in the manufacture and inspection of Ford parts. Inspection machines that have photo-electric cells, or electric eyes, and audio amplifiers like those for radio, are used to check precision. Automatic machines, for example, can inspect 1500 piston pins an hour. And if they vary in dimensions more than one ten-thousandth of an inch they are automatically rejected. The high capacity of these machines makes it possible to inspect every single piston pin, rather than a percentage of the production. Such methods further insure the high quality of Ford parts.

Experience and equipment in manufacturing is vitally important. Without it there would be no certainty of high quality. That is another reason why Genuine Ford Parts are so dependable in quality—the best parts you can buy for Ford cars and trucks. Make sure that you get Genuine Ford Parts. Buy them from a Ford dealer or from garages that display the Genuine Ford Parts Sign.

Checking the angle, pitch, diameter and lead of thread gage by an improved optical method.

FORD MOTOR COMPANY **DEARBORN, MICHIGAN**



PLANS FOR A SOLID MODEL OF A

Beautiful New Cabin Plane

The finished model, how the wings are fastened, and the various parts before they are assembled. Complete working drawings are given at the top of the page. The scale of the model in comparison to the full-size airplane is ⅜ in. equals 1 ft.

ONE of the most attractive cabin biplanes with radial engines is the Beechcraft. The negative staggered wings, the landing lights built into the wheel "pants," and the graceful curves give the ship a character all its own.

Fourteen units are required for this model, or fifteen if the cowl is made separately as shown in the photographs. Be sure to have the fuselage blank absolutely square all ways before you mark the profiles and do any carving.

You will notice that the wing-tips are tapered on the bottom instead of the top, as is usually done. Shape the wings in one piece, cut it in two, and cut one stub off each half of lower wing. Small nails with their heads cut off, or short pieces of wire, hold the wings in place. Long lips at each end of the wing struts, which fit into slots in the wings, keep them in position. Scratch the lips with a sharp point and set in casein glue or cement.

The "pants" are shaped by marking the profiles on the blanks and cutting them out with a fine-toothed coping saw. Cut away the square edges and round up smoothly with sandpaper. Nail or glue them to the wing stubs.

The propeller is made of three pieces. Scratch the ends of the blades and glue them in slots in the wooden hub.

Coat the model with clear nitrate dope, then paint the complete plane with light blue enamel. Trim it as shown with a rich dark blue. To mark the dark blue areas accurately, cut out paper patterns representing the parts to be left a light blue. Then lay the pattern on the model and trace around them, using a hard pencil on the wooden parts and a scriber on the metal. Use black for the windows, cowl recess, tires, and other details. Paint the landing lights yellow, and the wing-tip lights red and green, as indicated.

In constructing highly simplified models of this type, much depends upon neat painting.—Donald W. Clark.

WHY TAKE CHANCES WITH EYES?

Good light costs so little

Eyesight is priceless . . . good light is cheap. Why take unnecessary risks? You can buy a genuine 100-watt Edison MAZDA lamp, the size that is so fine for reading, writing or working, for only 25 cents, and the smaller sizes, 75-watts and under, for only 20 cents.

These good lamps not only help guard against eyestrain . . . they protect your pocketbook by using electricity economically. And they don't burn out too soon. Why take chances? Look for this mark GE on every bulb you buy. General Electric Co., Nela Park, Cleveland, O.

EDISON MAZDA LAMPS
GENERAL ELECTRIC

Basement RIFLE RANGE

Gives Hunter Year-Round Practice

By
Leonard F. Merrill

BY BUILDING a basement rifle range, any sportsman can keep his shooting eye in trim, to say nothing of smelling a little burned powder once in a while. Good light on the target, a bulletproof backstop, a rig for carrying the paper targets from the firing line to the backstop, and the necessary police permission are all one will need.

To be on safe side, as soon as you have finished your range, have the local police look it over and give their permission for you to use it. This is particularly necessary in the larger cities and may save later complications even in the smaller places.

Materials. Sheet steel or boiler plate, 1/8 by 30 by 30 in. Steel wire about No. 14, long enough to reach from firing line to target. Flat iron, 1/16 by 3/4 by 24 in. Spring paper clip or film clip (1 in. is large enough). Lamp shade or reflector, dark green on outside, with socket fixture set in at angle of 45 deg. One double and one single pulley about 1 in. in diameter. An old sewing machine treadle wheel or similar grooved wheel. Thin strong cord, such as hard-twist cod fishing line, long enough to reach from firing line to target and back. Two pails of sand, nails, screws, etc.

Backstop. Make the box of wood 3/4 to 1 in. thick. Cut two boards 6 by 30 in. and two 6 by 32 in. Nail a strip or cleat about 3/4 by 3/4 by 25 in. to each of the 30-in. pieces on the inside as shown. These are to support the steel plate. Assemble box but leave top removable. Fasten it to sides with one screw in each end. Screw a 6- or 8-in. board across the front about in the middle, so that it can be renewed. This is where most of the bullets will cut the box.

Insert the steel plate and fill space behind with sand to deaden the ring of the steel when a bullet strikes it. About 3 in. of sand in bottom of box will catch the lead after it has hit the plate.

Fasten strips of wood or flat iron to sides of backstop to suspend it from the first-floor joists, or make a stand to hold it upright from the floor. The hangers are better. Place backstop at end of basement away from stairs to prevent possibility of injury to anyone coming unexpectedly downstairs.

Target Carrier. Have firing line 50 ft. from the target or as far as the basement will allow. Leave room for prone shooting, so do not get the line too near the wall. A post is required at the firing line. A "2 by 4" fastened securely at top and bottom will answer the purpose. Fasten one end of steel wire above middle of backstop, and the single pulley about 1 in. above wire. The other end of the wire and the double pulley are fastened onto the post. Pull wire as tightly as possible to see that it is all clear, but do not fasten it until the target carrier has been made by cutting the 3/4-in. iron into two pieces and bending them as shown. Rivet the spring clip to the shorter piece. Drill four holes in the longer piece of iron—two for wire and two for cord. Fasten the short iron to the long one with two rivets.

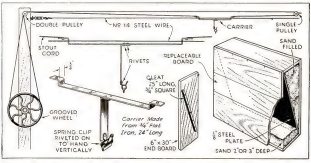
String carrier on wire, pull wire tight and fasten it to the post securely. Tie one end of cord to target end of carrier; pass other end up through single pulley and down over one side of double one. Fasten wheel to post at convenient height, and pass cord around it. Continue on up with cord, over other side of double pulley, and fasten to end of carrier.

Operation. Put target in clip and turn wheel to carry target down to backstop. Turn wheel in opposite direction to bring target back. A wad of tire tape wound around wire to stop carrier about 2 in. from backstop will prevent jambs and breakage. Place light as near target as possible, either directly above or below the center, with reflector throwing full light onto target. Be careful the light is out of line of fire. The popular .22 short cartridges are quite satisfactory for this short range.

Are you interested in making sporting equipment? If so, send a post card to the Home Workshop Department and mention any subjects you would like to see published in future issues of this magazine.

COLORING LAMP BULBS FOR MODEL RAILWAYS

COLORED model-railway train lights often become splotched as the coloring matter wears off. These lights also cost more than plain lights as a rule. Both red and green lights, however, can easily be made at home. For red lights use ordinary finger-nail polish of the dark red shade known as garnet. For green lights obtain at the drug store a small quantity of malachite green and dissolve it in clear lacquer. When repainting old lights, first remove the old coloring with acetone or lacquer thinner.—W. V. VAN SCOYK.



Diagram, greatly shortened, showing arrangement of wire and cords for target carrier; side view and sketch of the carrier itself; cut-away perspective view of the backstop and an end board

march 1935

MODEL RAILWAY BUMPER AND LIGHT

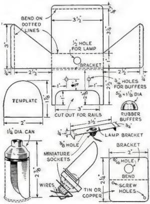
The tin is painted light gray or white and, while still tacky, sprinkled with beach sand

OLD tin cans supply material for many interesting and realistic model railway accessories. For example, an imitation concrete bumper that looks just like the real thing may be made as shown from a sheet of tin only 7 by 9 in. It is folded on the dotted lines and soldered from the inside.

A miniature lamp socket is soldered into the ½-in. hole in the bracket, which is cut from another piece of tin. The bracket is then centered under the hole in the top of the bumper, and soldered in place.

The bumper is painted white or light gray, and when the paint has become tacky, white beach sand is sprinkled on. After the paint has thoroughly dried, dust off the excess sand. Then attach the two 1⅛-in. diameter rubber buffers with No. 6-32 screws and nuts. The dimensions given are for an O-gauge system. One side of the bumper is grounded to the running rail, and the wire is connected to the third rail.

Another tin-can job is the little flood light, which was made from a ten-cent tooth-powder can. The drawing shows how to make a template of paper that can be glued to the can to serve as a guide for the tin shears. The neck of the can, after the bottom has been cut away and the body shaped, is soldered into a hole in the bracket, and a miniature socket is fitted. The light may be used in a variety of ways.—HAROLD W. LONG.



How both fittings are made. Note the template used in cutting the tooth-powder can

This bumper for O-gauge track is made of tin with rubber buffers and a 12-volt red light

Flood light to be hidden behind a building or tree for illuminating any special feature

RECORDING DRUM FOR INSTRUMENTS

(Continued from page 65)

drill plates, and bolt in place. These brackets can be bolted directly to baseboard, but it is more convenient to mount them on a metal base strip. This makes possible adjustment of brackets endwise by slipping paper shims under the strip. End play in drum should be restricted. When drum is mounted, force darning needle in drive hole up to the eye. Bind with a turn or two of fine wire through eye.

Solder up a brass standard to hold a wire pointer. Screw it near end of drum. If wire is threaded and a nut put each side of standard, close adjustment is possible. This point is set above drum flange opposite end point of needle swing to indicate position of chart end at start of a run.

Drive. Use cheap alarm or electric clock. Take out glass, snip off hands, and remove dial. To hour-hand stub, solder an L-shaped piece of 1/16 by ¼ in. brass, having hole in projecting leg to slip over darning needle. Mount clock on a base to raise its center even with drum center.

Pointer. Cut strip of 1/32-in. aluminum 1¼ by 12 in.; fold lengthwise; hammer bend flat; clamp fold between two metal or hardwood strips, and fold wings outward. Hammer them flat also, remove, and trim to width. Mount as shown for sidewise pivoting and with vertical hinge motion for lifting pen to remove or replace chart paper. Bend up sides of clevis base and bolt clevis to it. Use a hardwood dowel over the screw for rigid clamping. Rivet pointer to clevis, stiffening the angle with a brass triangle each side.

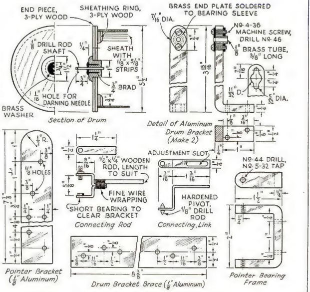
The dial is removed, and a brass ell replaces the hour hand for driving the drum

The drum partly sheathed with strips of pine. Each temporary brace is removed when reached

The pen is a double triangle of brass, or better, tempered steel. File to point and hone on oilstone. Test writing qualities. If it catches on paper, "write" on a razor hone to smooth it. Attach to pointer with rivets and a wrapping of fine wire.

Pivot. Cut ⅛-in. drill rod about 1¼ in. long. Grip in drill chuck. While revolving at good speed, file cone on end, finishing it, if possible, with superfine flat needle (jeweler's) file. Be sure to get a needle point, then blunt it very slightly by rolling the superfine file over the end as the rod whirls. File other point in the opposite direction, without removing and reversing the rod. As diameter gets small, finish cutting off with light pressure of needle file. Make pivot glass-hard by heating red-hot and dropping in pan of cold water. Sandpaper scale from center, and solder in clevis-base hole.

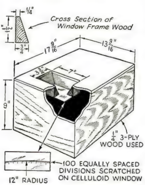
Bearing Frame. Bend, drill holes, and tap bearing holes. Make (Continued on page 81)



Detail drawings of drum and bearings, pointer bracket and bearing, and connecting rod and link

A RECORDING DRUM

(Continued from page 80)



The cover for the drum has a celluloid window marked with a scale for accurate reading

bearings by gripping drill-rod stock in vise and prick-punching the end. Finish with a punch made like a pivot, but with a less acute point, so that the pivot makes contact at the very bottom, reducing the diameter to a mere point. Thread bearings, file squares on shanks for wrenches, harden, and screw in place with washers added to lock them. Pointer should move with a fraction of its weight, yet with no bearing play that can be detected. Mount bearing frame on a strip that is bolted in turn to a steel bracket for attaching to baseboard. Pivot center should be opposite center of drum length.

For horizontal alignment, tighten needle clevis so that needle presses against one end of drum. Swing it to other side, and if it does not touch, loosen the drum base-strip screws and shim the strip at that end.

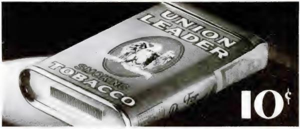
Cover. Center the window over drum, and glaze with sheet celluloid on which 100 equal divisions standing for miles per hour have been scratched. A cross-arc of 12-in. radius indicates motion of pen.

Anemometer Cam. As described in the January issue, the wind gauge was equipped with a dial calibrated for four revolutions, the divisions being proportional to the square of the velocity. While this is satisfactory for a direct-reading dial, it is not suited at all for the limited compass of the 6-in. chart. For instance, the pointer moves less than 1/10 in. between zero and 1 M.P.H., and between 48 and 49 M.P.H. it shifts about 4½ in. Proportioned thus, a chart reading to 100 M.P.H. would show only ⅜-in. deflection for 25 miles, and velocities from 75 on would occupy nearly 2 2/3 in.

Conversion of the movement into divisions directly proportional to the velocity is made possible by a cam designed with radii increasing in length as the square of the velocity, pushing a following roller (skate wheel) outward against the tension of a spring. The drawing, outside, is the exact size, and the accuracy of the recording depends on the care with which the cam is made. It can be roughly cut with a hacksaw from ⅛ in. thick annealed tool steel and filed to shape. The reverse curves at the ends fit the skate wheel and act as stops.

Drill shaft hole, make chisel mark on underface at start and end of cam curve, and temper cam like a cold chisel.

Remove clock spring from anemometer and lengthen shaft with ¼-in. gas pipe. Drill a 1/16-in. hole through one end and through the bolt it joins, (Continued on page 83)



Complete Construction Kit FOR A *ClipperShip* M*odel*

EVERYTHING you need to make a beautiful little miniature model of the famous American clipper *Sea Witch* is contained in a construction kit offered by the Popular Science Homecraft Guild. Unlike all previous clipper ship models, this one has been so greatly simplified that anyone can build it. Indeed, it is what is called a "pocketknife" model because so much of the work can be done with a penknife and a few single-edged razor blades.

The hull of the model is 9½ in. long, but the over-all length is 13 in., and it stands 8 in. high. The kit contains the hull carefully sawed to shape by hand from accurate master templates; half a dozen pieces of pine cut to approximate sizes for the deck fittings and boats; hardwood for the keel, stem, sternpost, rudder, and other parts; three sizes of round stock for the masts and spars; fiber for crosstrees and caps; thin hand-dyed linen rigging cord of the finest quality; thread, small chain, beads, fine wire, casein glue—in fact everything including paint.

Postpaid Complete $1.50

Popular Science Homecraft Guild,
381 Fourth Ave., New York, N. Y.

Please send me a complete construction kit and a blueprint for building a miniature model of the clipper ship *Sea Witch*. I inclose $1.50.

Name ....

Address ....

City.. State....................
(Print very clearly)

NOTE: This kit is not sent C. O. D.

What Shall I Make Next?

YOU can double the pleasure you get out of your home workshop by using great care and discretion in choosing good projects to make. Whenever you are in doubt as to what to build next, consult our blueprint list. The following list gives a wide selection, but if you do not find exactly what you want, send a self-addressed stamped envelope for our complete list. Note especially the projects marked with a dagger (†).

Our blueprints are each 15 by 22 in. and cost 25 cents a sheet (except in a few special cases). Order by number. The numbers are given in italic type and follow the titles. When two or more numbers follow one title, it means that there are two or more blueprints in the complete set. If the letter "R" follows a number, it indicates that the blueprint or set of blueprints is accompanied by photographically illustrated instructions which supplement the drawings. If you do not wish this supplement, omit the letter "R" from your order and deduct 25 cents from the price given. Instructions alone are 25 cents each.

SHIP AND COACH MODELS

{Construction kits are available for some of these models. See page 108}

Aircraft Carrier—U.S.S. Saratoga (18-in.) and flush deck destroyer (6¼-in), *226-227-R*	$ .75
Battleship—U. S. S. *Texas* (3-ft. hull), *197-198-199-200*	1.00
Bottle, Clipper Ship in, *121-122*	.50
Clipper Ship (20½-in. hull), *51-52-53-R*	1.00
Clipper, Simplified (9½-in. hull), *219*	.25
Constitution (21-in. hull), *57-58-59-R*	1.00
†Cruiser *Brooklyn* (8-in.), *236*	.25
Cruiser *Tuscaloosa* (11¾-in.), *234*	.25
Destroyer—U. S. S. *Preston* (31½-in. hull), *125-126-127-R*	1.00
Galleon *Revenge* (25-in.), *206-207-208-209*	1.00
†*Hartford*, Farragut's Flagship (33½-in. hull), special prints *221-222-R*	1.50
Mayflower (17½-in. hull), *83-84-85-R*	1.00
Miniature Coach and Covered Wagon for Decorating Boxes, etc., *202-R*	.50
Motorboat, 29-in. Cruiser, *63-64-R*	.75
Motorboat, Working Model (20-in.), *196*	.25
Liner—*Aquitania* (9-in.), *225*	.25
†Liner—*California* (12½-in.), *251*	.25
Liner—*Manhattan* (12 in. long), *204*	.25
Liner—*St. Louis* (11-in.), *231*	.25
†Privateer of 1812—*Swallow*, a Baltimore clipper (13-in. hull), *228-229-230-R*	1.00
Santa Maria (18-in. hull), *74-75-76-R*	1.00
Stagecoach with horses, *144-145-146-R*	1.00
Steamboat, *Mississippi* (19½-in.), *94-95-96-R*	1.00
†Steamships *Savannah* (3 in. over all) and *Atlantic* (6 in.), *235*	.25
†Trading Schooner (17½-in. hull), *252-253*	.50
†"Treasure Island" Ship *Hispaniola* (7-in.), *237*	.25
Viking Ship (20½-in.), *61-62-R*	.75
Whaler—*Wanderer* (20½-in.), *151 to 154*	1.00
Yacht *Rainbow* (7½-in. hull), *233*	.25
Yacht *Sea Scout* (42-in. racing), *106-107-R*	.75
Yacht (20-in. racing), *48-R*	.50

FURNITURE

Bench, Fireside, Colonial, *187A-188A*	.50
Chests, Treasure, *78*	.25
Coffee Table with Spiral Legs, *245A*	.25
Drafting Table, *189A*	$ .25
†End Table, American Empire Style, *241A*	.25
Floor Lamp with Tripod Base, *243A*	.25
Footstool, Upholstered, *240A*	.25
Magazine Rack, Ladder-Back Style, *250A*	.25
Mirror Frame with Split Turnings, *246A*	.25
†Pier Cabinet and Hanging Shelves, *77*	.25
†Lamps, Modern (no turning), *93*	.25
Sewing Cabinets, Two, *31*	.25
Smoking Stand, Modern Design, *238A*	.25
Stool, Scoop-Seat (chair height), *242A*	.25
Table, Four-Leaf Card, *239A*	.25
†Table, Tavern, and Scroll Mirror, *105*	.25
Tables, Tile-Top (wood and metal), *249A*	.25

RADIO SETS

†All-Wave Portable (battery), *217-R*	.50
Amateur Short Wave Receiver, *155*	.25
Amateur Radio Transmitter, *183-184*	.50
Amplifier, Three-Stage Audio-Frequency, *42*	.25
†Five-Tube Short Wave (A.C. or D.C.) *223*	.25
Full Electric Headphone Set, *130*	.25
One Tube (battery operated), *103*	.25
Screen-Grid Set, *109*	.25
Short-Wave Converter Unit, *137*	.25

BOATS

*Canoe, 16-ft. Canvas Covered Kayak, with sail, etc., *192-193-194-R*	1.00
*Duck Boat, Folding, *170-R*	.50
*Outboard Racer, 10½-ft., 114 lb., *211-212-R*	.75
*Sailboat-Motorboat, Combination (15 ft., cat rig), *131-132-133-R*	1.00
Marconi Rig with Jib for Above, *133A*	.25
*15½-ft. Runabout or "Sportboat" (outboard or inboard motor), *175-176-177-R*	1.00
*13-ft. Utility Rowboat (can be sailed or used with outboard motor), *224-R*	.50

NOTE: Full-size patterns for any boat marked with an asterisk (*) will be drawn to order for $1.50 extra. Simply add this amount to the cost of the blueprints. About one week is required to fill orders for patterns.

MISCELLANEOUS

Acrobatic Monkeys Toy, One-Legged Table, and Hat and Coat Rack, *248A*	.25
Bird House, Log-Cabin, *244A*	.25
Doll's House, Colonial, *72*	.25
Doll's House Furniture, *73*	.25
Microscope Kit, Portable, *220*	.25
†Star Chart, Perpetual, *214*	.25
Tie Rack, Extension Book Rack, and Turned Box, *247A*	.25
Toy Airplane Cockpit with Controls, *114*	.25
Toy Birds and Animals, Jig-Sawed, *56*	.25
†Toy Drill Press, Lathe, Saw, etc., *113*	.25
Toy Dump Truck, Fire Engine, etc., *101*	.25

Popular Science Monthly
381 Fourth Avenue, New York

Send me the blueprint, or blueprints, numbered as follows:

....

I am inclosing..................dollars..................cents

Name ....

Street ....

City and State..

Please print your name and address clearly.

Built from our Blueprint 202-R

UNIQUE
Coach-Model Box

MINIATURE models can be put to many practical uses. For example, they can be used to ornament the top of small boxes for jewelry, trinkets, cigars or cigarettes, handkerchiefs, gloves, or stationery. Our Blueprint No. 202-R, price 50 cents, shows how to make a beautiful little Concord coach for this purpose, and also how to construct a miniature covered wagon for use as a semi-automatic cigarette container. Our smaller ship models may also be scaled down and used to ornament boxes of various sizes and types.

A RECORDING DRUM

(Continued from page 81)

and put a nail through for a cotter. Also drill cotter holes for test lever and cam. Remount anemometer on roof. (For true measurement of wind velocity, anemometer should be elevated on a mast at least 15 ft. above roof, avoiding eddies and air pockets. In this case the connecting shaft should be a built-up hollow wooden one, made as light as consistent with strength and stiffness.)

TURN drive pulley and fit it with wooden clamp, nailed on. Make similar clamp to bolt to cam, and add these to anemometer shaft. For the lower bearing spindle, which resists sidewise motion of cam, insert ⅛-in. drill rod in a hardwood plug driven into end of pipe, keying it with a pin; or better, screw on a cap having the spindle soldered in a hole drilled in it. A rigid steel bracket on wall or suitable support from roof, having a bearing hole for the spindle, completes this assembly.

If skate wheel on follower lever jumps off cam, make it triangular in form, with two well-separated hinges, one above the other, to give rigidity.

Drum Connection. Mount the driven pulley assembly vertically on wall where it can connect with drum mechanism. It is equipped with cone bearings, with gears at lower end.

Support the recording base on brackets at proper level with gears. Make an offset connecting link to clamp to its bracket, having radius equal to radius from center of the spur to center of the pivot in its rim. Two connecting-rod clevises fitted with hardened cup bearings and connected with a wooden rod of suitable length transmit motion from gear to pointer. Owing to play in gear teeth, some lost motion is inevitable, but can be reduced by pressing gears together to bind a little.

One or more springs may be hooked to follower arm to get necessary tension, and the loop which passes around cam follower can be moved to vary leverage. At 100 M.P.H., when cam has extended springs to limit, the pull at wheel must be about 4 lb. At the start there should be no tension, but the connecting wire should begin to strain the spring as soon as motion starts. In the anemometer twist of 300 deg., the pointer pen moves in a chord of 6 in.; if it moves more, loosen clamp screw that holds connecting link to bracket, and lengthen its lever; if pen moves too little, shorten lever. To bring pen to zero, pivot the link slightly to right or left on its clamp screw.

Adjust tension of spring so that a 1-oz. pull on test lever, with a radius equal to that of the anemometer at the vane center, causes an angular deflection corresponding to the velocity established for the dial calibration (around 12.85 M.P.H.).

Operation. Mount chart paper, and ink the pen. Regular recording ink is best. If this is hard to get, mix a little water color with glycerine, put a drop between the nibs, and the pen will not dry during a 12-hr. run. Since chart papers ruled to fit this drum cannot be purchased and hand ruling would be very laborious, use a plain bond paper held on drum with rubber bands at ends. Start the chart at some convenient time, say 7 A.M., and replace it at 7 P.M.

FOR reading chart, cut plywood rectangle 7½ by 18 in., and nail wooden strips along the ends and one edge to enclose a chart sheet. Divide the long strip into spaces representing hours, halves, and quarters, and label them to correspond to the chart. Cut a strip of celluloid 4 by 6½ in., trimmed along the edges to curves of 12-in. radius, and scratch division marks for the wind velocities. By laying this over chart and against base molding of board, the velocity at any time can be read. If you prefer, lay out a complete blank chart on a sheet of celluloid, with vertical curves at 15-minute intervals.

Join Our Model-of-the-Month Club and Build the Famous

S.S.*California*

FIRST ALL-ELECTRIC OCEAN-GOING MERCHANT VESSEL

Deck view of the *California* and, at top of page, a photo of the model resting on tin foil

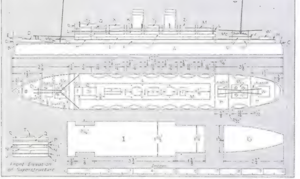
MODEL of the MONTH
No. 8 DESIGNED BY

Theodore Gommi

ARE you a member of the Popular Science Model-of-the-Month Club? If not, why don't you join now? We have an especially interesting model this month—the electrically driven ocean liner *California*. To this ship goes the distinction of being the first all-electric ocean-going merchant vessel.

For building this beautiful little water-line model, we have prepared a special construction kit containing all the materials required to make every part. With each kit goes a full-size blueprint and a long bulletin containing minutely detailed instructions for assembling the model. The price is only $1, postpaid anywhere in the United States. All you need do to become eligible for the Model-of-the-Month Club is to obtain one of these *California* kits (see page 108) and return to us the application card you will find in it. You will receive a membership certificate and will be entitled thereafter to participate in all activities of the club.

Not only in a series of American ships, but in any history of the development of the steamship, the *California* merits an important place. The electric drive had been successfully



For the dimensions of parts not detailed and for additional information, see list of materials employed in United States naval vessels for many years, but it was not until the Panama Pacific Line built the *California* in 1927 for its intercoastal route that the commercial possibilities were realized.

In constructing this model of the *California*, thin layers of balsa wood are cut out and glued together by the method described in previous articles (see particularly P. S. M., July '34, p. 78, and Sept. '34, p. 76). The scale of the model is 1 in. equals 50 feet, which makes it 12½ in. long.

If you have suitable materials at hand for building the model, you can obtain the full-size blueprints and detailed instructions alone for 25 cents. Please order Blueprint No. 251.

Members of the Model-of-the-Month who joined prior to this month are entitled to receive a copy of the instructions free, provided they send a self-addressed, stamped envelope. Ask for Model-of-the-Month Bulletin No. 5.

List of Materials

BALSA WOOD

No. of Pieces	T.	W.	L.	For
1	½	1⅝	12½	A
2	½	⅞	⅞	Funnels
1	⅛	1⅝	1¾	D
1	⅛	1⅝	6¾	F*
1	⅛	1⅝	2¾	G
1	⅛	1⅝	6⅜	I
1	⅛	1⅝	6½	J*
1	⅛	1¼	6¼	K*
1	⅛	¾	6⅛	M*
2	⅛	3/16	1⅝	P* & R*
1	⅛	¾	¾	S*
1	⅛	1¼	15/16	U
1	⅛	½	½	W*
1	⅛	¼	¾	X*
1	⅛	⅜	½	Y*
1	⅛	⅜	¼	Z*
1	⅛	½	⅝	Mb*
1	⅛	⅝	¾	Mc*
1	1/16	1⅝	2¾	B
1	1/16	1⅝	12½	C
1	1/16	1⅝	½	E
2	1/16	⅛	3/16	N*
2	1/16	1/16	1⅜	O*
1	1/16	¾	⅞	Q*
1	1/16	⅜	⅜	T*

FIBER BOARD

No. of Pieces	T.	W.	L.	For
1	1/64	1⅝	9¼	H
1	1/64	1⅝	6½	L*
1	1/64	1⅝	1	V
2	1/64	½	⅜	Large hatches*
1	1/64	⅜	¼	Small hatches*
9	1/64	3/32	⅛	Winch bases*

MISCELLANEOUS

9 pc. wood 1/16 in. round, ⅛ long, for winches*

2 pc. wood 1/16 in. round, 2¾ long, for masts*

Pins: 8 with heads removed, 1½ in. long, for derrick booms*, and 32, 1 in. long, for davits*; 6 with heads attached, 1 in. long, for small ventilators*, and 6, 1⅞ in. long, for large ventilators*.

1 pc. thin stiff wire about 2 in. long for flagpoles and boom supports.

Paint: Black for side of hull unit, funnels, 9 winches and bases, 6 large ventilators, 2 small ventilators, and pieces *X*, *Y*, and *Z*. White for superstructure unit, forecastle unit, foremast base, 4 small ventilators, 2 flagpoles, and stripes on funnels ⅛ in. wide and ⅛ in. from top (or use a thin white paper strip). Brown for masts, 8 derrick booms, 1 derrick boom support, and piece *T*. Buff (or brown and white mixed) for topsides of *D*, *S*, *W*, *Mb* and *Mc*, and for topside of hull unit from 1⅜ in. from bow to 2⅝ in. from bow, and from 3 in. from stern to the very stern.

Cement or glue and sandpaper. (A 1/16-in. drill and a No. 70 drill will be found useful, if available.)

Note: All pieces marked with asterisk (*) are ready for final assembly when cut to the given dimensions. All dimensions are in inches.

Simply Made
PROJECTOR
THROWS PICTURES ON SCREEN

PHOTOGRAPHS and picture post cards can be shown to friends in a more satisfactory and graphic way by throwing them on a screen with a projector like that illustrated.

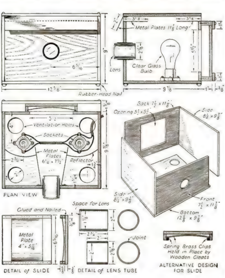
The author used an inexpensive eyeglass known to opticians as "diopter 4.00," which has a focal length of 10 in. Other lenses, such as those used for reading glasses, may also be used. The larger the lens, the clearer the projected picture will be.

If a lens other than that specified is obtained, its focal length must be found, because the depth of the projection box must correspond to the focal length of the lens. Go to the darkest corner of the room, point the lens toward the window, and move the lens until a clear image of the window is thrown on the wall. Then measure the distance from lens to wall. This is the focal length.

The lens is held in a cardboard tube, which slides inside another cardboard tube. Turn a piece of wood to exactly the same diameter as the lens. Cut a 3-in. wide piece of flexible, smooth-surfaced cardboard, and wrap it tightly around the wooden cylinder. Trim it with a knife until the ends just meet; then paste gummed paper strips over the joint. Square the ends of the tube with a skew chisel, and wrap another strip of cardboard around it, joining the ends on the opposite side. Glue the two tubes together and wrap tightly with a piece of 1-in. bandage. When dry, trim off the ends as before, but let the second layer project 1/16-in. over the first at one end to provide a rabbet in which the lens may be glued. A piece of paper is now wrapped around the first tube, and the second and larger tube is then built up in the same manner on top of the first.

For the box itself, 3/8-in. plywood is best. Bore the hole for the lens holder in the center of the front panel, and the four 2-in. holes in the bottom for ventilation. Also saw the opening for the picture in the rear panel, using a coping saw. The sides, ends, and bottom may now be glued and nailed together.

The pictures are mounted on a slide, which is shown in detail. A fine sawcut is made at an angle in the two sidepieces to hold a thin metal plate (tin will do). The metal should be large enough to curve toward the back. In this way all parts of a picture will be in better focus. The simplest way to hold the pictures against the metal plate, no matter



How to make the box, lens holder, and slide

Projector with top removed. An additional shield or hood is fastened to front of cover

what their size, is with paper clips. A more workmanlike method is shown in the alternative detail. Two small cleats are added to the sidepieces of the slide so that two narrow strips of spring brass may be used to clamp the top and bottom of the pictures.

It is well to make two or three slides so that a helper can mount the pictures, which can then be shown without interruption. The slide is moved across the opening in the back on two runners screwed to the box.

Two porcelain light sockets are now screwed to the bottom and wired, and four rubber-head nails are driven into the bottom for feet.

The metal plates screening the light, as well as the two reflectors, are made and fastened as shown. These may all be cut from ordinary tin sheets. With the exception of the two reflectors, however, the tin should be painted a flat black, and also the tubes holding the lens. The interior of the box and the slides should be stained black. A black stain may be made from ½ oz. powdered nigrosine dissolved in ½ pt. denatured alcohol. The outside may be finished as desired.

The painted plates, the reflectors, and the tubes are now remounted in the box. The best lights to use are 200-watt projection lamps, which take up little room and give a strong light. Photographers' flood lamps give good results, but burn only for about two hours. Ordinary 75- or 100-watt lamps may also be used. Clear glass bulbs give more light than frosted ones.

The top is now fastened with screws, the picture mounted upside down, and the box placed about 4 ft. from the screen. A silver-colored screen gives a very clear picture. Move the lens back and forth until the picture is in focus, and proceed with the show. The projected picture of a post card measures about 12 by 19½ in.

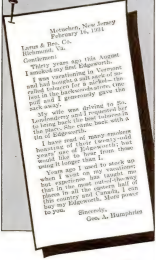
Printed or written words can be read by placing the projection box parallel to the screen and holding a mirror at an angle of 45 deg. to the box. The resulting picture, however, is not as clear as when projected directly on the screen.—Herman Hjorth.

List of Materials

No. of Pieces	Description	T.	W.	L.
2	Top and bottom	⅜	9⅞	12⅝
2	Sides	⅜	7½	11⅞
2	Ends	⅜	8¼	9⅞
1	Slide	⅜	6-5/16	6-5/16
2	Cleats for slide	⅜	⅝	6-5/16
2	Runners	⅝	1	12⅝
2	Cleats for runners	⅜	1	12⅝
2	Plates (tin)		6¼	7½
2	Plates (tin)		3⅛	11⅞
1	Plate (tin)		2¾	11⅞
1	Plate for slide		4	5-11/16
2	Reflectors		7	7½

Two light sockets and lamps; 10 ft. of lamp cord with plug; lens; 4 rubber-head nails.

Note: Dimensions are in inches and finished sizes.



Metuchen, New Jersey
February 16, 1934

Larus & Bro. Co.
Richmond, Va.

Gentlemen:

Thirty years ago this August I smoked my first Edgeworth.

I was vacationing in Vermont and had bought a salt sack of so-called tobacco for a nickel—the best in the backwoods store. One puff and I generously gave the sack away.

My wife was driving to So. Londonderry and I requested her to bring back the best tobacco in the place. She came back with a tin of Edgeworth.

I have read of many smokers boasting of their twenty-odd years' use of Edgeworth; but would like to hear from those using it longer than I.

Years ago I used to stock up when I went on my vacations; but experience has taught me that in the most out-of-the-way places in all the eastern half of this country and Canada, I can buy my Edgeworth. More power to you.

Sincerely,
Geo. A. Humphries

LAST CALL FOR $2,000 GUILD CONTEST

(Continued from page 71)

pect to send. This handful of clubs promises 118 exhibits. These clubs are such a small proportion of the whole, however, that the figures have little significance, but a breakdown of the various reports does reveal one especially interesting point. The largest number of entries is promised for Division 4 of the contest, which is restricted to furniture made with power-driven tools. Only a few years ago, small woodworking machines for amateur use were rare and expensive. Few home workers had them. Now, however, they are in such wide use that this division promises to be one of the most popular in the entire contest.

Exhibit of Pocono's Homeworkshop Club at Monroe County Hobby Show, Stroudsburg, Pa.

The entries of the few clubs that have reported are distributed quite evenly through the various divisions of the contest. While Division 4 leads, there is a difference of only four exhibits between it and Division 7, which covers toys and novelties. Only one entry behind this is Division 3, furniture made with hand tools.

All exhibits must be shipped in time to reach Chicago not earlier than March 18 or later than March 25. The necessary entry blanks and labels are being sent to all club secretaries.

The Chicago Premier Homeworkshop Club has rallied loyally to the assistance of the contest committee and will do everything possible to make visiting club members feel at home during the exhibition week. Earle G. Peek, president of that club, and Alexander Maxwell, secretary, have been added to the membership of the national contest committee. Mr. Maxwell has had wide experience in exhibition work, having been connected with the World's Fair almost continuously during the entire period of its construction, operation, and dismantlement. He designed and erected some of the building fronts and also served as maintenance supervisor for the Colonial Village.

The following national exhibition delegates have been nominated by their clubs and appointed as members of the contest committee: Dr. C. W. Grauel, Denver (Colo.) Homeworkshop Club; Arnold Schultz, Dixon (Ill.) Homecraft Club; Donald Stow, Queen City Homecraft Club of Elmira, N. Y.; Clyde Newman, Elmhurst (Ill.) Homeworkshop Club; R. D. Brooks, Topeka (Kans.) Homeworkshop Club; and W. O. Watkins, Tucson (Ariz.) Homeworkshop Club.

CLUB ACTIVITIES

Elmhurst Homeworkshop Club, Elmhurst, Ill. Plans are being completed for the club's annual exhibition, which will be held the first week in March. So late a date had to be fixed because the Christmas toy program grew to such magnitude that it absorbed all the energies of the club members and left little time for individual projects. To finance the work of repairing and constructing toys, the club ran a benefit show in one of the school auditoriums. The performance was advertised and the sale of tickets stimulated by means of a child's playhouse, 6 by 8 ft. and 8 ft. 6 in. high, which was built by one of the members so that the club could offer it as a prize to the holder of the lucky ticket to the show. The house was designed in English cottage style, half-timbered, with a fireplace chimney, and finished inside complete to electric lights and curtains. If built to order it would have cost $175. A local merchant gave the club the use of the second floor of a building on the main street for a toy repair shop. Coal was donated, and all the club had to do was to mention what was needed in order to get it. Officials of the Illinois Emergency Relief assisted by furnishing a list of families with children requiring assistance, and the churches did the same. These lists showed the name, age, and sex of each child so that appropriate toys could be given. The club has more than doubled its membership since it was organized in June, 1934. Among its members are carpenters, retired business men, salesmen, engineers, machinists, an undertaker, a barber, and a grocer.

The Pocono's Homeworkshop Club, Stroudsburg, Pa. The club display won first ribbon at the Monroe County Hobby Show, which attracted about 5,000 visitors. Three ribbons were won by individual members. The first ribbon went to J. R. Stanton for an end table and gavel; second to L. C. Brown for a sculptured head; third to James Moore for wood carving. The club's assortment of Christmas toys were turned over to the Elks for distribution. Demonstrations have been given on a number of subjects, and four were scheduled recently for a single meeting night. A talk on photography was given by Warren Card, the club's photographic expert, and on woods by Oram P. Hoffman. Leo Werson is the club's adviser on leather craft.

Eugene Craftsman Club, Eugene, Ore. The "Gypsy Carvers", who won first prize for wood carving at the Oregon State Fair and have made large carved decorations for the new library building of the University of Oregon, recently gave a demonstration of their work for the benefit of this club. The meeting was held in the Senior High manual training shop. At another meeting in the machine shop of Ralph Pierce, a demonstration was given on the cold rolling of steel, punch-press blanking and forming, electric welding, and metal planing. Some of the machines used had been constructed by Mr. Pierce. Methods of spinning different yarns and weaving cloth were explained by A. S. Kaufman at a meeting held in his basement workshop. He made the demonstration on a homemade spinning wheel and loom. He is a professional weaver, but also makes a hobby of doing hand weaving at home.

The Homeworkshop Club of Cleveland. Through the coöperation of P. C. Neale, a member of the club, an entertainment was given for all the members by the Electrical League of Cleve-

(Continued on page 89)

$2,000 GUILD CONTEST

(Continued from page 88)

land. The program included a get-together party, a "science of seeing" show, and talks by Mrs. Celia Hudson, director of the Electrical League lecture bureau, and W. E. Connley, an electrical engineer. A number of electrical gifts were given as door prizes.

Spokane Homecrafters, Spokane, Wash. The members could hardly believe their eyes at a recent demonstration on the use of a skew chisel in wood turning, given by Knute Engdahl, president of a sash and door company. He did stunts that looked impossible with no other tool but the chisel. His engagements do not permit him to attend meetings more often than once a month, but he has been made an honorary member. . . . Other recent demonstrations included one by Chase Charlton on the metal turning lathe; another by J. B. Maxwell, a paint company representative, on finishing; and a third by Paul Pugsley on metal work. Mr. Pugsley also displayed a remarkable collection of fine tools. . . . Since this club is limited in membership and has no vacancies, W. E. Mitchell, the president, and the other officers and members are anxious to see another home workshop club started in Spokane with unlimited membership. They will give any desired assistance to that end.

ADVISORY COUNCIL

●

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Capt. E. Armitage McCann
Founder, Ship Model Maker's Club

Dr. Francis G. Pease
Astronomer, Mt. Wilson Observatory

Frank A. Vanderlip
Banker and Publicist, New York

Topeka Homeworkshop Club, Topeka, Kans. Thirty boys are now regularly attending the meetings of the junior auxiliary conducted by this club in coöperation with the Y. M. C. A. Among the hobbies followed are woodworking, archery, model airplanes, leather work, photography, microscopy, and cement modeling. Because of the growth of the boys' division, Clyde F. Cook, president of the club, in an address before the Optimist Club, suggested that woodworking and metalworking tools be provided by any of his listeners who had some to spare. The Optimist Club took up this idea and broadcast an appeal to the entire city. The boys' auxiliary is the first one started by any club affiliated with the National Homeworkshop Guild and has been successful from the start. . . . "The Topeka Homeworkshop Club News Bulletin" is now being issued in greatly improved typographical style. Besides club news, there is a page of workshop hints.

Jacksonville Homeworkshop Club, Jacksonville, Fla. To en- *(Continued on page 92)*

Be Popular!
BECOME AN EXPERT
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Jack did, and now he is invited to all the parties. . . . .

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Thousands of boys and girls all over the country have found the Harmonica a short cut to popularity. At school or at play, at parties or meetings, the harmonica player is the center of a group of swaying, singing boys and girls. Thousands of schools have harmonica bands. If you haven't one in your school, why don't you suggest it to your teacher.

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Without costing you a cent you can learn to play the Harmonica like a professional in a short time. Mail the coupon below for free Illustrated Instruction Book "The Art of Playing the Harmonica."

You don't have to know one note from another. This book *tells* and *shows* you just what to do. Just follow the simple instructions and in a short time you'll be amazing your friends with the way you can perform.

A lot of big boys love the Harmonica too. Here's what Dizzy Dean the famous St. Louis pitcher says. "Do I play a Harmonica? You bet I do. I've played a Hohner Marine Band for years and it's a winner."

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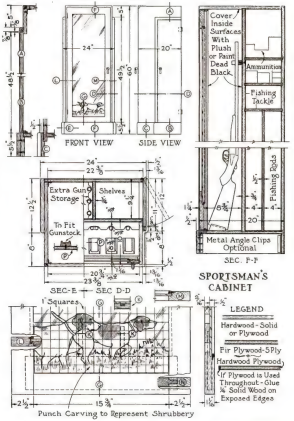
Sportsman's Cabinet

HOLDS GUNS AND FISHING TACKLE

WOODWORKERS who also like to hunt and fish will get double enjoyment in constructing this unusually attractive and practical cabinet. There is ample room in front, behind the glass door, for the display of five guns, and additional room is provided in the back for the storage of other firearms, as well as compartments for fishing rods and tackle, ammunition, and other accessories.

The extensive use of plywood in this design allows the construction to be kept relatively simple. The dog silhouettes, which are lightly carved, provide a touch of decoration that relieves the otherwise severely plain case. Detail *K* shows how wood inserts are made to strengthen the silhouettes. Choose the plywood with an eye to a distinctive grain pattern, and apply a good finish. Hardware of the casement window type and hinges of the so-called "invisible" type are the most appropriate, if readily obtainable.—DONALD A. PRICE.

Doors at each side give access to storage compartments hidden behind the main gun rack



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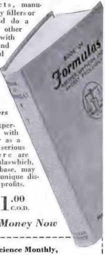

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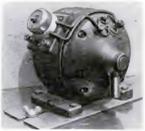
SWITCH AND BED PLATE IMPROVE SHOP MOTOR

With the advent of the modern home-workshop machine units, a switch attached directly to the motor became so essential that most manufacturers now build one into the frame of their fractional horsepower motors. An old-style motor can be modernized in the same way by the simple method illustrated at a cost of about 75 cents.

The switch base is a block of hard rubber or fiber ¾ by 3 by 3 in., suitably drilled. Grooves and counterbores in the underside provide space for the wires, the heads of the binding-post screws, and the nuts for attaching the switch. The block is scribed to the curve of the motor and ground to shape on a fairly coarse wheel. Shallow holes are drilled into the motor frame and tapped out with a bottoming tap to receive the screws.



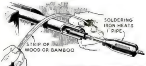
Old home-workshop motor improved with a convenient switch and easily adjusted bed plate

Another device shown in the photograph is a 3/16-in. slotted steel plate to which the motor is permanently bolted with machine bolts, countersunk into the back of the plate. The slots in the ends of the plate should be at least 3 in. long and wide enough to slide smoothly along a ⅜-in. bolt.

Such a plate enables the operator to move the motor from one machine to another with minimum effort, and requires only two ⅜-in. bolts with wing nuts for securing it. Furthermore, the belt tension may be regulated easily.

Two pieces of leather (an old fan belt or strap will serve) clamped between the base of the motor and the plate will materially deaden the sound of the motor and lessen vibration.—R. G. Bullard.

RIBS FOR MODELS BENT OVER HEATED PIPE



Variable temperature bender

Ribs of thin wood or bamboo for a model boat or airplane may be bent more conveniently if a variable temperature bending iron is rigged up as illustrated. A 2-ft. length of 1-in. pipe is set up in a vise and an electric soldering iron is inserted in one end. The ribs, if of wood, are dipped in water for a few minutes, then bent to shape on the hot pipe. Bamboo ribs do not require to be wetted. The proper temperature for the bending can be found by sliding the piece to be bent along the pipe.—Stephen A. Fritsch.

WHY DO NEW CARS NEED "LIGHT" OIL ?

You've heard friends talking about the new cars of this year needing "light" oil. Or your dealer has advised it, if you have one of the new motors. What's the reason for this insistence on "lightness"?

Just this: the car makers, in their constant efforts to step up the *efficiency* of your motor, have been fitting the wearing surfaces *closer and closer together*.

This helps to seal the motor against power loss. But it presents a serious problem in lubrication. Your oil now has only a fraction as much space in which to flow between the wearing surfaces, a space too narrow for any but a "light" oil.

Obviously, the "lighter" the oil, the *better it has to be*. Not only because there is a *thinner film* of it on the working parts (though that is reason enough!) but because with the new high-speed motors, your oil is subjected to *greater heat and tension* than ever before. Therefore, if you would avoid motor damage, buy only the best!

You will probably find that your motor consumes a little more oil with the "light" grades. But the slight extra cost here is easily offset by the extra mileage from your gasoline... an economy made possible by the new closer-fitted motors.

There is no reason to worry about whether your motor will be "broken-in" safely with "light" oils... *if you buy the best*. That's why you'll find more new car owners using Quaker State this year than ever before. Quaker State Oil Refining Co., Oil City, Pa.

●

"First choice of Experience"

QUAKER STATE MOTOR OILS

The Home Craftsman's MOST USEFUL TOOL

One home expert says: "I can do 60% of many jobs with Nicholson Files." Another says: "Forty", some go as high as 70%.

There is little doubt that the world's most popular file — Nicholson — is the home craftsman's most useful tool.

Here are ten of the most popular Nicholson Files selected by a vote of expert home craftsmen: Metal working—Round, Flat, Mill, Half Round, Three Square; for Wood Working—Cabinet Rasp, Half Round Wood Rasp, Last Makers Cabinet Rasp, Flat Wood Rasp.

Hardware stores everywhere carry Nicholson Files — priced to meet popular demand. Nicholson File Company, Providence, Rhode Island, U. S. A.

Genuine
NICHOLSON FILES

A FILE FOR EVERY PURPOSE

$2,000 GUILD CONTEST

(Continued from page 89)

courage an exchange of shop ideas, a few members are called on at each meeting to describe briefly some particular "kink" they have found useful. . . . A talk on the use of paint, stain, and varnish was given recently by H. C. Conklin, superintendent of a paint manufacturing company. . . . Two hardware companies have assisted the club by providing machines for demonstration purposes. In fact, such a large variety is always available that members can try out practically any type of machine ordinarily used in the home workshop. . . . An auction sale of projects donated by members enlivened the club's successful first annual Christmas party. Besides the members and their wives, there were many visitors who took advantage of the auction to pick up novel and attractive articles for Christmas presents. The toys made by the club for distribution to needy children were on display, in addition to the projects made especially for the auction sale. Four prizes were given—an attendance prize for ladies, another for men, a third for children, and a fourth for the member who submitted the most unique project. The auction netted $79.35, which was spent for clothing for poor children.

Monarch Homecraft Club, Moose Jaw, Sask., Canada. This club is a division of the Monarch Club of the St. Andrews Church of Moose Jaw. Organized about eight years ago, the parent club had no other activities than a regular Sunday afternoon meeting, four or five banquets and a dance each year, and various amateur theatrical revues. It has now been split up into study and hobby groups, of which the Monarch Homecraft Club is one. The members constructed the scenery for the annual revue as their first club project.

Springfield Homecraft Club, Springfield, Mass. The organization meeting was attended by 125 of whom 45 joined the club, followed later by 12 more. It is expected that the 100 mark will be reached in the course of a few months. . . . An instructor in the Springfield Technical High School gave a wood-turning demonstration at one meeting, and the program proved so interesting that the club did not adjourn until 11:45. There were about 75 present. At an earlier meeting Peter M. Marsh, a local contractor, exhibited wood carvings and gave a demonstration on the art of carving . . . . Charles C. Gay, secretary of the club, attributes its success and the large *(Continued on page 93)*

Newly Chartered Clubs

THE following new clubs have been organized and granted charters by the National Homeworkshop Guild since the February issue of POPULAR SCIENCE MONTHLY was published:

Alliance Homeworkshop Club, Alliance, Nebr.

Brunswick Homeworkshop Club, Brunswick, Me.

Emmetsburg Homeworkshop Club, Emmetsburg, Iowa.

Kewanee Homeworkshop Club, Kewanee, Ill.

Lincoln Homeworkshop Club, Lincoln, Nebr.

Manchester Homeworkshop Club, Manchester, N. H.

Newcastle Homeworkshop Club, Newcastle, Calif.

These clubs are in addition to those listed in previous issues. All new clubs will be announced in these columns as soon as possible after being chartered.

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Build your own projects with CASCO and get a new idea of glue strength. Whereas ordinary glues set merely by evaporation, CASCO hardens chemically . . . and becomes proof against moisture and heat.

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1935 CATALOG SENT UPON REQUEST

THE WILSON CO. **BRISTOL, CONNECTICUT**

$2,000 GUILD CONTEST

(Continued from page 92)

Publicity Will Help Your Club Grow

By keeping your home workshop club in the spotlight and obtaining the right sort of publicity, you can gain new members, keep up the interest of the old ones, and win the support of your community. It is therefore important to send reports of all meetings promptly to the local papers and occasionally offer the editors good human-interest photographs. Be sure also to send the more important news of your club and a selection of your best photographs to the Guild Editor, Popular Science Monthly, 381 Fourth Avenue, New York, N. Y.

number of visitors who attend the meetings to the enthusiasm of the members and the excellent coöperation that has been given by the local newspapers.

Greater Lawrence Homeworkshop Club, Lawrence, Mass. More than eighty members were present at the second meeting of this club. An address was given on the use of power tools, followed by a wood turning demonstration by one of the members.

Middletown Homeworkshop Club, Middletown, Conn. For several days before they were distributed, the 350 Christmas toys made by club members for Middletown's poor children were exhibited in a local store window with the club's charter in the center of the display . . . . Arthur Bronkie, a master wood turner, gave a demonstration at a recent meeting and explained some of the finer points in the operation of a wood-turning lathe.

Newcastle Homeworkshop Club, Newcastle, Calif. The monthly business meetings are held in the offices of the Placer County Bank at Newcastle, and the intermediate meetings at the home workshops of various members. Among the organizers and charter members of the club are a lumber company manager, the local telephone company manager, a bank cashier, an insurance agent, and an accountant.

HOW TO START A HOME WORKSHOP CLUB

The best method of starting a home workshop club is outlined step by step in a free bulletin you can have by filling out the coupon below. Send for it at once.

To amateur craftsmen the Guild offers the opportunity of enjoying real coöperation and companionship in their hobby. It is the first time this opportunity has existed in the home workshop field. The purpose of the Guild is solely to promote handicraft of all types. The officers and directors of the Guild are giving their time without pay, and the movement is entirely noncommercial. All the services, resources, and prestige of the Guild are placed freely at the disposal of the local clubs.

National Homeworkshop Guild
c/o Popular Science Monthly
381 Fourth Avenue, New York, N. Y.

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This new "Delta" Scroll Saw is another great step forward in scroll saw performance. Enables you to use *fine* blades at *full motor speed* without danger of breakage. Has many other novel and useful improvements. This year the Delta line of motor-driven woodworking tools is more complete than ever before. Delta standards of efficiency, quality, and convenience have been strictly maintained—and Delta prices still kept at their low levels. Good compact motor-driven tools are within the reach of all. Every woodworker will find the new 1935 Delta line of unusual interest.

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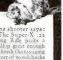

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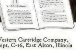

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Each key can be slid out on the chain as needed

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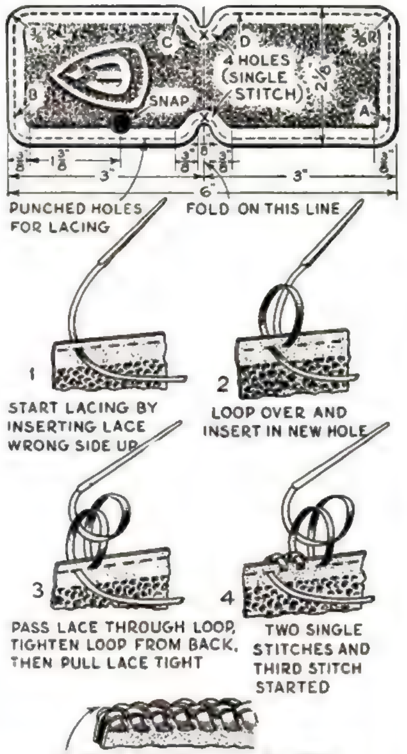
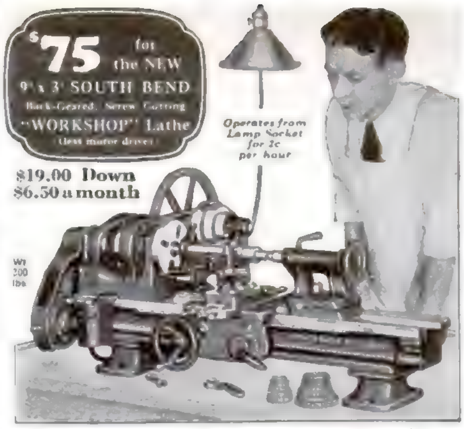
The case can be made from any kind of leather, but tooling calf is necessary if a design is to be impressed in it. The most popular colors are black, brown, tan, and blue with lace either to match or in a darker color for contrast. Materials needed are one piece of leather 2⅛ by 6 in., 2½ yds. of 3/32-in. lace, one snap fastener, and one key chain obtainable in five-and-ten-cent stores.

Lay out the design on paper. Moisten the underside of the leather and fasten it to a board with two or three thumb tacks at the edge. Place the design on the leather, fasten with thumb tacks, and trace with a 4H pencil, being careful not to press too hard. Remove the layout and carefully indent the design in the leather with a tracer. Lay a dime on each corner and trim off circular as shown at *A*, rounding the corners ⅜ in. each way. Keep the leather *(Continued on page 95)*



The key case as it appears when tooled and punched, and the method of lacing the edges



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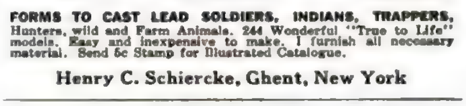
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NEW SILENT KEY CASE

(Continued from page 94)

moistened on the underside and work the design with leather modeling tools or suitable substitutes until sufficiently raised. The stipple effect is made by using a rounded tool and tapping the leather until the desired effect is obtained. Allow to dry.

Punch holes for the lacing on a line 1/8 in. from the sides. Touch up all cut edges with waterproof drawing ink or leather dye before lacing. Beginning at *A*, use a double or over-edge style of lacing as shown in the five lacing sketches. At *X*, lace four holes single stitch to avoid bulkiness when folded. Lace to *B*, fold over, and lace edges together from *B* to *C*. The end of the lace at *A* is concealed under stitches at *A*. From *C* to *D*, lace as from *A* to *B* to leave an opening for the key chain, making the single stitch again in four holes at *X*. Run the lacing needle under several stitches and cut. This end is now concealed, leaving no evidence of the start or finish of the lacing.

Measure for a snap fastener 1 3/4 in. from the bottom and 3/8 in. from the side as shown, punch a hole for the top of the fastener and insert it. This will give the position of the bottom part. Punch the hole and insert the bottom part. Insert the key chain and polish the leather.

Learning to lace is not difficult if you study the sketches. Start lacing by inserting the lace wrong side up as in the first drawing. Run your fingers the whole length of the lace to prevent twisting, and insert the lace in the next hole, wrong side up as before. This is all there is to single or over-and-over lacing.

To lace double or over-edge style proceed as in the third sketch, looping the lace through the loop formed in the previous operation. Tighten the loop from the back and then pull the lace tight as shown in two stitches of the fourth sketch.—A. W. MOREAU.

MIRROR CONCENTRATES LIGHT ON MICROSCOPE

BY THE use of a concave mirror such as is found in an ordinary shaving glass, an amateur microscopist can concentrate the light from an overhead lamp or from a nearby table or floor lamp on the substage mirror of his microscope. The mirror should be placed about a foot from the microscope. A few minutes' experiment will determine the distance and proper angle.—JAMES H. FRY.

GLASS STAINING DISHES

GLASS cup supports for bedposts, obtainable at ten-cent stores, make excellent staining dishes for microscopic work. They resemble the staining dishes used by professionals and can be had in two sizes at the rate of two for five cents.—ERNEST M. OLSON.

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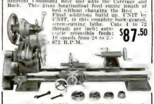

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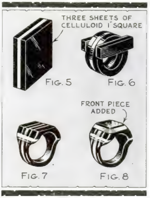
MODERN RINGS FROM OLD TOOTHBRUSH HANDLES

(Continued from page 63)

has been completed thus far, place it in a vise and ream out the inside with a good rat-tail file to the correct finger size. Next, finish the slope between the shank and the built-up portion of the ring, using a half-round file. Work down the outside of the shank with a flat file to the desired thickness; then bevel off the top and bottom edges with a rat-tail file to overcome bulkiness. Study the rings shown in the photographs, as well as Figs. 3 and 4.

The next step is to sandpaper the entire ring with No. 2 sandpaper, inside and out. Follow this with No. 0 sandpaper to smooth out any possible scratches. Get a small amount of pumice stone in powdered form and mix with water to a thick paste, dab this on a cloth lying flat on the table, and work the ring in a circular motion to remove all roughness and bring to a smooth finish. Rinse it with cold water occasionally and wipe with a dry cloth. Continue until all marks of filing are removed. Use the same method to smooth the entire inner and outer surfaces of the ring. The final step is to polish with a dry flannel cloth until a high luster is obtained. A paste wax polish such as is commonly used on automobiles will be found helpful in bringing out an extremely brilliant luster. Strangely enough, the ring will acquire a still more beautiful polish after being worn for a week or two, from contact with the warmth and natural acids of the body.



Rings may also be built entirely from sheet celluloid, the finger hole being drilled out

Variations of this method are possible. For example, if you wish a band of contrasting color running through the otherwise plain shank of the ring, the piece shown in Fig. 1 can be split through the center with a very fine saw and the cut edges smoothed to a perfectly flat surface. A thin sheet of celluloid of contrasting color is then cemented between the two rings with acetone. Similarly, two thin sheets may be placed between the shank and the two thicker pieces shown in Fig. 2. The author's first ring was made in this way from a black and a white comb.

The flat front section of a ring can be further ornamented, if desired, by setting in a stone or by covering it with gold or silver foil, either plain or cut to form an initial, monogram, or design. Foil used in this way should, of course, be covered with a thin sheet of transparent celluloid.

If sheet celluloid *(Continued on page 97)*

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61
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Gilson Slide Rule Co., Stuart, Fla.
Slide Rule Makers since 1915

MODERN RINGS FROM OLD TOOTHBRUSH HANDLES

(Continued from page 96)

is available, it is really easier to build a ring up from it than to use the thick material, although a slightly different method must be followed. The sheets range in thickness from .05 to .25 in. Scraps left over in manufacturing operations may be obtained from any number of firms dealing in synthetic plastics at very reasonable prices. These scraps usually range in size from 2 by 3 to 4 by 8 in. They can be obtained in various thicknesses and in many colors, including beautiful imitations of pearl, mother-of-pearl, veins and mottles, stratifications, roll stratifications, imitation corals, and all colors of translucents, transparents and opaques, grained ivory, shell (plain and corrugated mottle), onyx, wood effects, plaids, checks, stripes, metallic, bronze pearl plain, bronze pearl with fancy blocks, bronze pearl in veins and stripes, and what is called "essence pearl."

WHEN working with scrap sheet material—say ⅛ in. in thickness—cut the pieces 1 in. square and lay three sheets on top of one another, welded with acteone between layers. For example, place black on bottom, saturate it with acteone, place a piece of white on the black, and another piece of black on top of the white. Drip acetone around the four edges to reënforce the outside. Let it dry for half an hour. Then you will have a solid piece ⅜ in. thick and 1 in. square (Fig. 5).

Drill out the center to a size slightly smaller than finger size, place the blank in a vise, shape off the four corners with a coping saw, and round the edges with a flat file. If the shank becomes too soft from the friction caused by the file, lay it aside for half an hour until it regains its natural state of hardness. You will then have a round shank, finished without any joints.

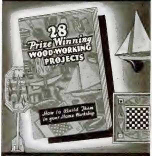
Cut two thin pieces of white 1 in. long and ⅜ in. wide and place one piece on top, across the shank, near the edge, and one on the bottom; then cut a piece of black, the same length and width as the white, and weld with acetone on the top and bottom of the white pieces, but make the black pieces three times as thick as the white (Fig. 6). Weld all with acetone. When dry, trim off both sides and top and finish as explained in the first part of this article (Figs. 7 and 8).

DON'T file or sandpaper a ring while it is still soft from the effects of the acetone or from the friction of the file. In the early stage, when the liquid is first applied, the celluloid becomes as sticky as tar. It takes from a quarter to half on hour to dry thoroughly.

If you would like to see other articles on celluloid craftwork published in future issues of POPULAR SCIENCE MONTHLY, *please send a post card to the Home Workshop Department.*

COTTON-MILL SPINDLES MAKE SPECIAL TOOLS

OLD cotton-mill spindles, when obtainable, are useful for a variety of shop purposes. They are made of good tool steel, and, if properly annealed, will made good reamers, drills, screw drivers, cold chisels, and the like. They come in sizes from 5/16 by 9 in. long up to ¾ by 30 in. long, approximately, the smaller sizes being tapered at one end. Annealing is necessary because they are glass hard. A fairly satisfactory way of doing this is to heat the spindle red-hot in the furnace, then shove it into the hot ashes in the ash pit, and leave it to cool until the next morning.—MARK A. COOPER.



HOW TO CUT A New Entrance

In Any Frame House

PUTTING an additional entrance in a frame house or even through the basement wall is not an especially difficult job.

First build the complete frame, consisting of side and head jambs, outside trim, and drip molding at head, as indicated in the drawing. Nail securely and brace so that it can be handled as a unit.

Then a rough opening in the wall should be cut in the desired location about ½ in. larger all around than the frame. Additional rough studding should be nailed in place at the side of this opening, and a header across the top.

If an entrance into the basement is being built, it may be necessary to cut the lower part of the opening through the foundation wall. If a spot can be selected where a basement window already provides this opening in the wall, much labor will be saved.

Temporarily wedge the frame in the opening and scribe a line around the trim on the siding. Remove the frame and nail a straight strip of wood along the scribed lines as a guide in sawing through the siding down to the sheathing.

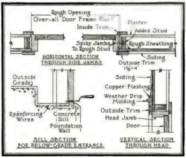
A straight strip of wood is nailed temporarily to the siding to guide the saw along lines marked from the frame itself as shown below

Paint the surfaces that will afterwards be inaccessible, and slide the frame back into the opening till the outside trim rests solidly against the sheathing, to which it should be nailed. The frame should also be nailed to the studding, using blocks between stud and frame near the nails so that the frame will not be forced out of line.

The opening between foundation walls and jamb should be filled with concrete of a stiff consistency, using temporary forms if necessary. Insert a copper flashing strip at the head of the doorframe. Fit and hang the door and, after patching up the plaster on the inside, nail the inside trim to the jambs.

The entrance illustrated is below grade, so the sill was made of cement. The side jambs were allowed to extend about 1 in. below the bottom of the door, and the cement sill was built up around them, level with the bottom edge of the door. Bottom clearance was insured by passing the trowel between the bottom edge of the door and the sill before the cement had set. If a wood sill is desired, it may be built into the frame at the start.—DONALD A. PRICE and ROY FROST.

The completed entrance and, below, the working drawings



The frame is held in the roughly cut opening to scribe the outline

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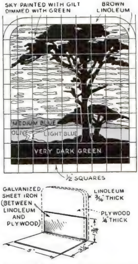
LINOLEUM BLOCKS FORM COLORFUL BOOK ENDS

PAINTED linoleum cuts, when properly mounted, form colorful and attractive book ends. They can be made with such simple tools as a gouge and a penknife, if no other chisels are available.

Copy the drawing full size by sketching through ½-in. squares, and trace the pattern on brown linoleum 3/16 in. thick. Outline with a small gouge or V-tool, and gouge out the spaces between the sky lines, making no attempt to smooth the cuts. Now snip a rectangle of heavy galvanized iron and bend it at right angles to hold the book end upright. Cut out the linoleum and a piece of ¼-in. threeply wood the same shape, for backing, and glue the two together with linoleum cement, placing the upright leg of the iron between.

These neat, light book ends are faced with ordinary brown linoleum, carved and painted

When dry, finish the piece as indicated. Paint the iron brown to match the linoleum, and glue a piece of green felt on the underside to prevent it from marring varnished surfaces.—E. M. L.



Pattern for laying out, gouging, and coloring the linoleum, and method of mounting it

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The drills are handy, yet never in the way

PHOTOS FERROTYPED ON SHEET CELLULOID

IF YOU do your own photo finishing and are partial to glossy prints, try using transparent sheet celluloid instead of the conventional ferrotype plates. The latter usually require the application of a waxing solution or other preparation to prevent the prints from sticking, but sheet celluloid does not need any preliminary treatment. It may be purchased at any large garage in the form of window material for storm curtains. Before being used, the new sheet or sheets should be washed with soap and warm—not hot—water and well rinsed. For subsequent use, the sheet is simply sponged with clean water.

Transfer the prints direct from the final wash water onto the sheet, lay them face down, place a chamois skin or a clean absorbent cloth on top, and roll them down fairly hard. The chamois will absorb the water which has been squeegeed from under the prints, leaving them merely moist instead of dripping wet. Be sure there are no air bells.

Stretch a string or wire in a dry, warm room and use it as you would a clothesline, by suspending the sheets from their upper edge with spring clothespins or photo clips. The prints will peel off when bone-dry.

It must, of course, be remembered that the best squeegeed prints are produced on papers labeled "gloss" or "glossy". Mat, or even semimat paper, will not do.—E. F.

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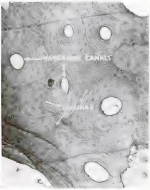
YOUR MICROSCOPE FINDS BEAUTY IN SKELETONS

(Continued from page 47)

stores, having a fine-tooth, slender blade, is excellent. Make some slices squarely across the bone, others parallel to its longest sides, and still others at angles.

With a fine, flat file make one surface of each section as smooth as possible. Then rub it on a piece of very fine emery paper or, better still, the surface of an oilstone from which all traces of grease have been removed by washing with benzine or dry-cleaning fluid. Finally, polish the surface by rubbing the piece on the clean surface of the finest razor hone you can obtain. Use water to lubricate the hone and oilstone.



Cross section of compact bone from the femur of a man. Large spots are Haversian canals

So far, one surface of the specimen has been ground flat and polished. The next step is to reduce the thickness of the piece until it is as thin as the finest tissue, and at the same time produce a perfectly uniform and smooth surface.

Place a drop of Canada balsam in the center of a microscope slide or a piece of any kind of glass. Heat the glass gradually over a gas or alcohol flame until most of the solvent has been driven from the balsam. While the balsam is warm but not hot, lay in it the piece of bone, polished side next to the glass, and press firmly against the glass with some instrument until the balsam has set. This requires only a half minute or so.

Now, with the bit of bone cemented firmly to the glass, you can file, grind and polish the upper surface with ease. Use water as a lubricant during the grinding and polishing operations. When the specimen has been made fairly thin, examine it frequently with the microscope so that you will not carry the grinding process too far.

Remove the piece of bone by adding several drops of xylol to the balsam, and carefully transfer it to another slide on which some fresh balsam has been placed. If necessary, wash the bone in xylol to remove dirt. You will have to handle the piece very carefully, with fine-pointed tweezers, for it is easily broken. Coat one side of a cover glass with a thin layer of balsam, press it over the bone specimen, and set aside to dry. Instead of mounting the specimen in balsam, you can mount it dry, or immerse it in some other mounting fluid such as glycerin or liquid petrolatum.

The microscope will reveal many interesting things about the bone. Perhaps the cross sections will prove *(Continued on page 102)*

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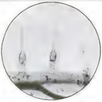

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Wollensak TELESCOPES MICROSCOPES BINOCULARS

YOUR MICROSCOPE FINDS BEAUTY IN SKELETONS

(Continued from page 101)

most interesting, for they exhibit the details of the structure more prominently.

You will see, in the typical bone section, many fairly large openings whose size and form vary considerably. These are the Haversian canals, through which nerves and blood vessels passed. In circular formation around these canals are the lacunas, minute openings that held the bone corpuscles and cells. These lacunas probably will look dark, like solid particles; but that is a trick of the light, for they really are openings, as an inspection by dark-field illumination will reveal.

RADIATING from the lacunas are tiny, threadlike processes, which appear to extend to neighboring lacunas. Each Haversian canal has several ringlike rows of these lacunas about it, so that the whole bone structure looks as if it were made up of laminated rods, which you see in cross section. The canals and lacunas are visible in longitudinal and diagonal sections as well, their forms of course being altered. You can see the tiny connecting threads between lacunas in all sections.

The microscopic examination of bone is more than a mere pastime. Extensive research has shown that animals and groups of animals all have characteristic bone formations. Very often there are peculiar shapes and arrangements of the lacunas. An expert microscopist, familiar with bone formations, can look at a tiny fragment and tell with fair certainty from what animal it came. This is sometimes of value in crime detection. Physicians can use the microscope to study diseased conditions of bone. Scientists who delve into prehistoric life can employ the microscope to identify with certainty bits of fossil bone millions of years old.

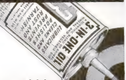
The method followed in making bone sections, that is, filing, grinding and polishing of thin slices until they are reduced in thickness to the point where they become almost transparent, can be employed for other specimens. The teeth of animals can be prepared in similar manner. However, the hard enamel covering many kinds of teeth presents an additional problem, for it is very hard and brittle, and does not submit easily to the ordinary saw. A hack saw can be used, but will dull quickly. A wheel charged with diamond dust, such as are used for jewel cutting, is much better. Perhaps a small hand hack saw, with the blade reversed so that the toothless edge is presented to the specimen, could be charged with water and powdered emery or carborundum and used for slitting teeth—if you have the time and patience. Once roughly cut, tooth sections are ground and polished in the same manner as bone.

There is no hard-enamel problem connected with the teeth of fishes. These have no heavy coat of enamel, and therefore can be cut easily with a saw.

THE shells of sea animals, being composed largely of limestone and other hard materials, can be worked into thin sections with the same tools as are employed for bone or teeth. Because of their greater brittleness, shell sections must be handled with greater care. Sometimes the thin sections must be left on the slide to which it was cemented while the second surface was ground and polished.

It is interesting to subject specimens of bone and shell to the action of acids, which remove the deposited mineral matter, leaving only the animal tissues. In fact, a common method of obtaining bone sections is to soak pieces of the material for days or weeks in acid until the min- *(Continued on page 103)*

HITS THE SPOT
AND STAYS WHERE IT'S NEEDED



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YOUR MICROSCOPE FINDS BEAUTY IN SKELETONS

(Continued from page 102)

eral matter has been removed, and then dehydrate, embed in paraffin, and section on a microtome like any other soft tissue. Microscopic stains can be employed on such specimens.

In a similar way, the animal part of a sea shell can be separated from its calcareous deposit with hydrochloric, nitric, or sulphuric acid, diluted with three or four parts water. Removal of the mineral material is accompanied by bubbling as carbon dioxide gas is produced. Use plenty of acid solution, so that when the bubbling stops, you will know that only animal tissue remains.

THERE are certain hard vegetable specimens that can be sectioned like bone or shell. The dense stones of various fruits, such as peach, cherry and plum, make excellent microscope specimens when cut into thin sections by the same methods as those used for bone.

Microscopists seem to favor balsam as the medium for mounting silica plant skeletons and similar objects when they are to be examined by polarized light. Bone sections also are mounted generally in balsam. Care must be taken to exclude bubbles so as to obtain perfect penetration of the balsam, and to prevent it from entering the openings in the bony structure.

The use of balsam as a mounting medium makes it unnecessary to carry the final polishing operations to a point where all minute scratches are removed. The balsam fills the smallest marks and renders them invisible or unobjectionable. Some workers claim, however, that balsam goes too far in this direction, in the case of bone, and blots out such details as the lacunas by filling them up.

When the ground and polished surface is to be rendered as smooth-appearing as possible without obliterating the lacunas and other desired details, the balsam can be heated on the slide until most of the solvent is removed, as was done in grinding the sections. Then it is allowed to cool until the point is reached where it is tacky, yet will not flow into the minute openings of the bone. The specimen is pressed against the balsam film and held until the balsam sets. Then a cover glass is similarly coated and pressed on top of the bone. This process may require a bit of practice before complete success is attained. Edges of the cover glass can be supported by allowing some fluid balsam, but not enough to soften that surrounding the bone, to run beneath them.

After seeing the beauty revealed in bone by your microscope, you will realize that one of the most fascinating things about this hobby is the way it converts ordinary and even repulsive materials into something full of unsuspected wonders.

From George J. Harris, of Lonaconing, Md., comes an ingenious suggestion for easily handling live insect specimens while studying their heads.

"TO EXAMINE the head of a live fly or other insect," he says, "make a small cone from paper. Glue the edges, cut a very small tip from the cone—leaving a hole large enough for the head of the insect to pass through—and place the insect in the cone. When it sticks its head through the opening, push some cotton into the cone to keep the specimen in place. A specimen held in this way can be placed under the objective, and many an interesting feature, heretofore unnoticed, can be viewed easily."

Construction of the cone, as described by Mr. Harris, is illustrated in the accompanying photographs.

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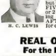
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CAST TOMBSTONES BUILD A NEW BUSINESS

THE lot of a skilled artisan is not an easy one when building construction is in the doldrums. So Henry Bell, plasterer, did some tall thinking. You can't sit idle long when you have a large family to support.

Among his friends was a young Frenchman, who, in more prosperous times, had been sculpturing figures and designs for architects. One evening, the idea of making tombstones from artificial stone was broached. It had possibilities and both Bell and his sculptor friend decided to give the suggestion a try.

The sculptor sketched a simple pattern for a "stone," sculped his model and gave it to Bell to cast in plaster. When the mold had hardened, Bell filled it with a mixture of cement and selected crushed granite. A few days later the cast was removed from the mold, "touched up" with a chisel by the sculptor and hand polished by Bell. So far, so good. The materials had cost only a few dollars and for a workshop they used Bell's cellar.

Now came the problem of marketing their product. The story, circulated by enthusiastic friends and neighbors, soon got around and within a month the first order had been executed. The low cost of the "stones" had a real price appeal and it was not long before an order was received for a mausoleum.

Today, after a year and a half of consistent hard work by Bell, his partner and two salesmen, the business has outgrown its basement beginning and is now housed in part of a small stone works. Small advertisements are being run in the local newspapers and what eighteen months ago was no more than an idea is now a well-paying family business that has all the earmarks of being not only permanent but one with a real future.

J.C.D.T., Hudson, Ont., Canada.

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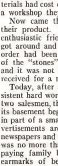
PRINT SHOP ON WHEELS



I WASN'T particularly disappointed to find a pink slip in my pay envelope one Saturday night. During my twelve years experience I had not only learned the printing trade from bottom to top, but had managed to

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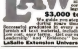

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PRINT SHOP ON WHEELS

accumulate a savings account that would put me in business for myself.

After sinking my few hundred dollars into a small but modern printing shop, I anticipated big things—but soon I learned that all the pluck, initiative, ambition and energetic effort within my being could not cope with established competition in an over-crowded field.

I used every weapon to secure business, except that of unethical price-cutting, yet the rewards scarcely paid the rental on my shop.

Something had to be done. I knew that a forced sale of my equipment would mean a tremendous loss to me, so the next best thing was to try to trade it for a more promising line. I inserted an ad in the "swap" column offering the business for "what have you."

My first—and only—reply to the ad was from a young man who had had experience in a job printing shop, but had branched off into the trucking business. He owned a good three-ton truck, and sought to trade it for my equipment. He confessed that the truck transportation business had been somewhat uncertain lately, and I, too, with Washingtonian honesty, admitted my disappointments in the independent printing shop game.

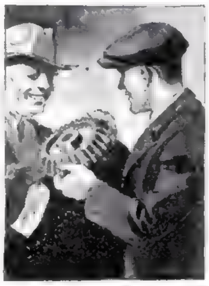
Realizing that we each apparently possessed "white elephants" as far as income was concerned, we considered means of co-operating and our ultimate decision was to attempt a novel experiment.

That was about a year ago, and now we have what we believe to be the most completely equipped, if not the *only* traveling job printing shop in the country. Instead of bringing business to the shop, we take the shop to the business, visiting villages and small towns where no shops are located. We give "while you wait" service on small and rush jobs, holding the bigger orders for future delivery when possible—and, believe it or not, a good portion of this work is done while our shop is traveling from place to place. We have one assistant.

Our portable shop is not spacious, and we must resort to a foot propelled press, but from the first day on the road we have been busy even to the extent of missing Sunday School!—Z.T., Branford, Conn.

• • •

STARTS SHOPPING SERVICE



BERT tossed aside his magazine. He wished glumly that he might find a job. There was very little business activity in the small New Hampshire town in which he lived, and the future looked black to him—nothing to do here, and no money to go elsewhere. What chance did a young man have? He rose and stretched—he supposed he might as well do that repair job on his old car.

The work had progressed only a little way when Bert found a part which needed

draw me!

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Copy this girl and send us your drawing—perhaps you'll win a COMPLETE FEDERAL COURSE FREE! This contest is for amateurs, so if you like to draw do not hesitate to enter.

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RULES

This contest open only to amateurs, 16 years old or more. Professional commercial artists and Federal students are not eligible.

1. Make drawing of girl 5 inches wide, on paper 6½ inches square. Draw only the girl, not the lettering.

2. Use only pencil or pen.

3. No drawings will be returned.

4. Write your name, address, age and occupation on back of drawing.

5. All drawings must be received in Minneapolis by February 25th, 1935. Prizes will be awarded for drawings best in proportion and neatness by Federal Schools Faculty.

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Ten Years' Promotion in One is a booklet that shows you how you can save years that would otherwise be wasted. Sending for it has marked the turning point in the lives of thousands upon thousands of men —and the coupon will bring it to you FREE.

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Will you wait till the golden years of your life are fast slipping away—or will you set your path toward success while you are still young enough to enjoy it?

Prove that you mean what you say when you say that you want to get ahead—by what you do with this coupon NOW.

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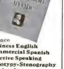

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Name ....

Present Position..................................

Address..

STARTS SHOPPING SERVICE

replacing. He walked over to the town's only garage. "No," they told him, "we don't carry that part in stock. We'll order it from Concord, and it should be here in a day or two."

He turned homeward, grumbling inwardly at the inadequacies of the town's stores and other places of business. "You can't buy anything here," he muttered under his breath, "except bare necessities."

And he was correct in his complaint. Everything else had to be ordered from Concord or Manchester, and the train service made delivery anything but prompt. This condition prevailed in practically all small towns. Suddenly he had an idea. There must be a lot of people in towns like this, he thought, who wanted things from the city every day—automotive parts and equipment, books and stationery, photographic goods, musical goods. Why wouldn't those people jump at the chance to get the things they wanted quickly and safely? There were three other villages between Bert's home town and Concord, and the roads were kept open all winter. He could drive his car to the city each morning, stopping at the garages and stores in each town to take orders. He could then make the purchases in Concord, and deliver the goods on his way home in the afternoon. It would cut at least twelve hours from the time now required to get anything under present conditions. People should be willing to pay a reasonable charge for such a service, he thought.

Bert put his plan into action the following week. At first, of course, business was slow. But news spreads rapidly in small towns, and Bert did a little inexpensive advertising. Soon business men and townspeople alike came to know of him and to depend upon him. Every stop yielded commissions.

Bert has bought a better car since he began his shopping service. He is steadily and profitably employed now, and his business is increasing all the time.—W. T. S., Warner, N. H.

Cash Prizes

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Manuscripts will be judged on the individual merits of the case and circumstances involved. Only stories in which the author's success, or that of some one known to the author, has been gained by some method of educational guidance, fitness for the job, or application to the work will be considered. We are not looking for the "get-rich-quick" type of story.

Manuscripts must be confined to 500 words or less. They must be true and, if accepted, authors must be prepared to give us signed statements to the effect that they are true. Manuscripts submitted and printed become the property of this magazine, and we are not responsible for the return of rejected stories unless postage is provided for this purpose. Address contributions to Success Story Department, Popular Science Monthly, 381 4th Avenue, New York City.

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Please send me, without obligation, your free book, "How to Secure a Government Position."

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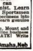

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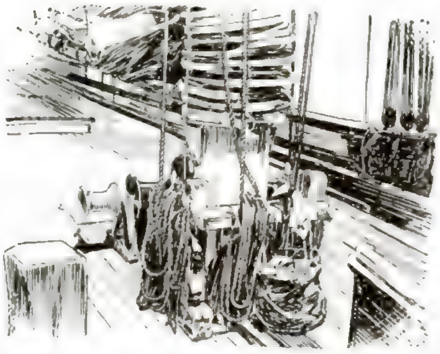
NEW SCHOONER MODEL

(Continued from page 69)



Mast rings and fife rail of *L. A. Simpson*

as shown in the detail drawing, just abaft the natural line of the hawse pipes.

If the model is to be of an auxiliary schooner, the stern will be differently built, so the lines for this are also given.

A schooner of this type would probably have a hand winch at both hatches, but no provision is made for a donkey engine, although many schooners carried one. The steering gear presumably was of the worm type.

Plans for the forecastle and aftercabin are given so that these parts can be fitted, if desired, with skylights that lift up and reveal the interior.

The spars are pine, and the rigging, wire. Rigging screws (turnbuckles) are indicated in place of deadeyes for tightening down the shrouds and backstays, but many masters still prefer deadeyes, because the lanyards have just a little give and there is nothing to become rusty.

Battens would probably be used in place of ratlines, but not invariably. Sometimes they extend to the caps, and occasionally all the way up. If ratlines are used, extend every fifth to the outside shrouds.

Fife rails at the masts were usual, but this vessel does not appear to have had them, so I have indicated pinrails under the rigging; these would be bolted to the timbers immediately under the wide top rail. There are no channels, and the chain plates are set in grooves in the hull.

Enlarged details of the iron work aloft are shown. These fittings are peculiar to schooners.

Quite a few of the more recent schooners have been fitted with a standing bowsprit, but the bowsprit and jib boom shown are more typical. This rig calls for the usual dolphin striker, martingales and backropes, with, as a rule, a short, knee-shaped cathead. The standing boom does not require these.

The shape and size of the sails can be taken from the plan, but if you are not familiar with sails it might be well to study a previous article I wrote on fore-and-aft sails (P.S.M., Sept. '32, p. 64). Before shipping the masts, do not forget to place the hoops and the hanks (rings) on them, as well as on the forestays for the jibs.

The jib sheets will be double, with long pennants, heavy blocks, and runners, one leading to each side—the weather one being slack. The fore and main boom sheets will be twofold with the lower blocks shackled to large rings, which are bolted through the deck to beams.

The tackles shown under the booms are to steady the booms on either side. The gaff-topsail tacks go on the lee side of the peak halyards and are dipped, if the schooner is to remain on one tack for long.

For a longer vessel with more masts, the added masts would be duplicates of the mainmast shown.

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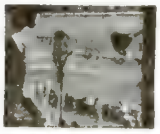

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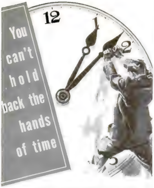

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At left is our new kit for making a model of the American clipper ship *Sovereign of the Seas,* as shown below

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The model was designed by Capt. E. Armitage McCann. It is 19¼ in. long on the load water line, 26 in. long over all, and 16½ in. high—an ideal size for the average room. The scale of the model in relation to the original ship is 1/12 in. equals 1 ft. The construction kit, which is illustrated in the photograph above, contains the hull members or "lifts" cut to shape, and all the necessary wood and other materials, including such hard-to-get items as very fine chain, colored flags made specially for this model, and anchors. Three blueprints and a set of illustrated instructions accompany each kit.

The *Sovereign of the Seas* is one of our standard ship models and ranks with the rest in accuracy and beauty, but it is easier to construct than most of the others. Hundreds of readers have already built the model with complete satisfaction, although they had to work from the blueprints alone without the advantage of a complete construction kit.

Another new kit this month is for a trading schooner, with lifts cut out, two anchors, brass ladders, sailcloth, three bottles of paint, one bottle of varnish, and two blueprints. See kit Y in the list.

The following list gives all our construction kits. The Model-of-the-Month kits are the easiest to build, being mainly of soft balsa.

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A.	Whaling Ship *Wanderer,* 20½-in.	$6.90*
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D.	Spanish galleon, 24-in.	6.45*
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G.	Elizabethan galleon *Revenge,* 25-in.	6.75*

NO. 5

NO. 2

KIT O—An 11-in. model of the S. S. *St. Louis*

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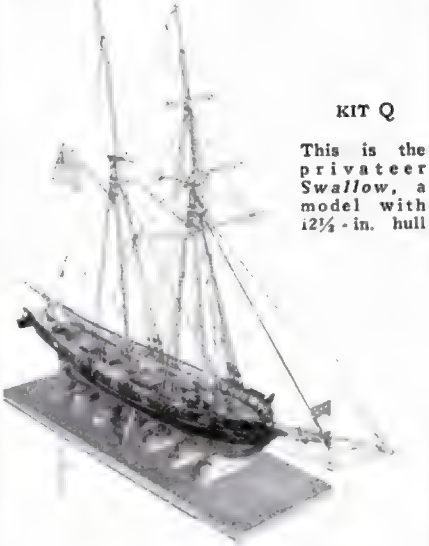

KIT Q

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GG.	Same with hull blocks shaped	7.25*
L.	Farragut's flagship *Hartford*, a steam-and-sail sloop-of-war, 33½-in. hull	7.95*
LL.	Same with hull lifts sawed	8.45*
Q.	Privateer *Swallow*, 12½-in. hull, with lifts sawed to shape	4.95*
V.	Clipper *Sovereign of the Seas*, 20½-in. hull, with lifts sawed to shape	4.95*
Y.	Trading schooner, three-masted, 17½-in. hull	4.90*

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F.	Liner S.S. *Manhattan*, 12-in.	1.00
H.	Cruiser U.S.S. *Indianapolis*, 12-in.	1.50
J.	Clipper ship *Sea Witch*, 13-in.	1.50

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P.	Cup yacht *Rainbow*, 7½-in.	.75
R.	U. S. cruiser *Tuscaloosa*, 11¾-in.	1.00
S.	S. S. *Savannah* (first steamship to cross Atlantic), 3½-in., and S. S. *Atlantic*, 6-in. (two models in one kit)	.75
T.	U.S.S. *Brooklyn*, armored cruiser in Spanish American War, 8-in.	.75
U.	*Hispaniola*, the ship in "Treasure Island," 7-in.	.50
X.	S. S. *California*, 12½-in.	1.00

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EASEL AIDS IN RETOUCHING NEGATIVES

Left: The easel open to show brass angle strips, lamp socket, and toggle switch. *Right:* With the negative carrier in place

AN EASEL that enables amateur photographers to retouch negatives can be made easily from scrap materials. It is really nothing more than a support for the negative carrier of a standard autofocus enlarger such as is used by thousands of camera enthusiasts. The base is a piece of any dense wood 1 by 5⅜ by 6 in. To the long edges are nailed ½-in. thick uprights, sawed off at an angle of 45 deg. as shown. These pieces are 6½ in. long and high, their front edges overlapping the base a distance of ½ in.

Six-inch lengths of ¼-in. brass angle stock (thin wooden strips will do just as well) are screwed parallel to, and about ½-in. below, the diagonal edges of the uprights. The negative carrier rests on these supports, being held in place by the leaf spring it already has on one of its edges. It is prevented from sliding downward by two nails driven into the front edge of the base. The sides of the easel are braced securely by a dowel stick inserted about two thirds of the way up, in the back.

For back illumination of the negative, a small, frosted 110-volt lamp with candelabra base is adequate. The lamp socket is held in place by an L-shaped brass bracket. A toggle switch mounted in the right sidepiece is connected in series with the socket and a piece of flexible lamp cord with a plug on its end. These electrical parts, if purchased new, cost about forty cents.

The negative to be retouched is placed on one of the pieces of glass of the negative carrier and held by a mask of the proper size, against which the spring fingers press. It can then be worked on conveniently without showing finger marks, and the whole carrier can be transfered to the enlarger for quick projection printing even before the retouching fluid has dried.

Several easels like this are in use by members of a camera club and have proved highly successful.—ROBERT HERTZBERG.

EASY WAY TO SALVAGE UNDEREXPOSED FILMS

WHEN a negative has been so far underexposed that it will not make satisfactory prints, it can be improved a hundred percent by dipping in a solution of oxidized pyrogallic acid. To make this, merely add twenty grains of pyro to a pint of water, and let it stand until the color becomes a dark brown. Leave the negative in this solution for five minutes, or until it is of an even yellow color; then wash and dry. The printing exposure will be considerably increased when using a negative treated in this way.—R.A.K.

Best Photos Among 3,000 in Contest

OUR readers are making remarkable improvement in both the quality and quantity of the photographs they are taking. This was made evident by the entries in the contest announced in our last November issue. Approximately 3,000 prints were submitted. The best of them were so beautiful in subject matter and so technically perfect that the judges found it required long study to decide on the winners, all of whom turned in work of exceptional merit. The list is as follows:

FIRST PRIZE, $25
G. A. Haraden, Manchester, Mass.

SECOND PRIZE, $15
R. R. Oakes, Waukesha, Wisc.

THIRD PRIZE, $5
William Deppermann, Orange, N. J.

FOURTH PRIZE, $1
Haden Hankins, Richmond, Va.

FIFTH PRIZE, $1
Augusta Strumpen, Philadelphia

SIXTH PRIZE, $1
P. A. Kinsey, Boyertown, Pa.

SEVENTH PRIZE, $1
A. T. de Coup-Crank,
Caracas, Venezuela

EIGHTH PRIZE, $1
C. J. Belden, Pitchfork, Wyo.

HONORABLE MENTION—*G. D. Aydlett, Norfolk, Va.; S. R. Bounds, Hagerstown, Md.; H. A. Clark, Summit, N. J.; J. A. Dreves, Elmhurst, N. Y.; E. Fernez, The Bronx, N. Y.; C. B. Flagge, Cincinnati, Ohio; H. T. Gisborne, Missoula, Mont.; R. H. Heiser, Washington, Pa.; A. T. Mitchell, Camden, N. J.*

The winners of the December Photo Contest will be announced next month.

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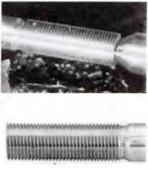
SMOOTHING THREADS CUT IN COLD-ROLLED STOCK

The threads are lapped smooth with a fine abrasive applied by means of a wooden stick

EVERY mechanic knows how difficult it is to cut a really smooth, clean thread with an engine lathe in ordinary cold-rolled stock. If the screw must be moved frequently to provide an adjustment for a machine, the rough thread will soon wear out the part into which it screws. It can, however, be given a high polish by a very simple method.

Take a thin piece of soft wood such as white pine, about two threads wide, and press the end firmly against the thread while the latter is rotating in the lathe. Let it follow the thread to the end. Repeat this process till the roughness of the thread has worn full-depth grooves into the end of the stick.

Now squirt some oil on the thread and apply flour of emery powder. Again apply the stick while the work is turning. After the stick has run the length of the thread several times, apply more emery powder and repeat. In a surprisingly short time, the roughnesses will have been smoothed away and the thread, after a bath in gasoline to remove the oil and grit, will look highly polished. The photographs below illustrate a typical thread in cold-rolled stock before and after the lapping process.—ALFRED P. LANE.



The first photo shows the thread as left by the tool; the second, after being smoothed

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OLD automobile connecting rods make economical shaft hangers for a small shop. The large end is easily bolted to a bench or joist, and the small end may be reamed out or bushed, as necessary.—A. B. TUNIS.

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☐ Patternmaker ☐ Machinist
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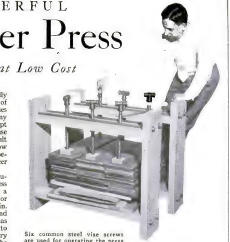
P O W E R F U L

Veneer Press

Built at Low Cost

VENEERING is generally recognized to be one of the most fascinating branches of woodworking, yet many amateurs hesitate to attempt it. That is partly because they think it very difficult and do not know exactly how it is done, but principally because they have no veneer press.



Six common steel vise screws are used for operating the press

There are two good solutions to the veneer-press problem. One is to buy a special metal veneer press for panels up to 24 by 24 in. This press is very strong and convenient to use, as it has only one screw. If it had to be purchased on the ordinary commercial basis, it would be an expensive piece of equipment, but it is distributed by a large glue company practically at cost in order to encourage amateurs to do veneering. The price is about $30.

The other solution, for those who do not wish to make so large an initial investment, is to build a press like that illustrated, which was designed by Albert Constantine, Jr. The hardware costs about $6, and the lumber, depending upon the locality and whether it is bought in the rough or cut and dressed to the exact size, from $4 to $6.50. The reason this press is so inexpensive is because the screws are carpenter's steel vise screws, sold by all large hardware stores and general mail-order houses.

List of Materials

4 pc. kiln-dried maple 1¾ by 7¾ by 33 in. for crossbeams.

4 pc. kiln-dried maple 1¾ by 7¾ by 30 in. for uprights.

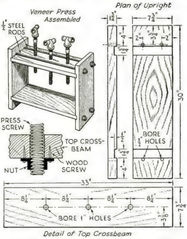
6 steel screws and nuts sold for making carpenter's vises.

8 steel rods ½ in. in diameter, 40 in. long, threaded at both ends.

16 nuts and washers for the rods.

Note: Dimensions for the wooden parts are the finished sizes, the stock being dressed square and true on all four sides.

To construct the press, finish the four uprights accurately to size with all edges square and true, and cut dados (grooves) with the utmost accuracy as shown to receive the ends of the crossbeams. Bore ½-in. holes as indicated. Then prepare the crossbeams with equal care and bore the three 1-in. holes in each of the upper beams. On the underside of these two beams fasten the large nuts which come with the vise screws. The two units of the press may then be assembled and held by means of the steel rods. These run directly beneath the lower beams and directly above the upper beams. Use steel washers on the ends of each rod, and tighten the nuts with a wrench.



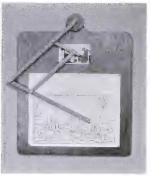
Sketch of one of the assembled units, drawings of the uprights and crossbeams, and how the nuts are fastened

In use, do not place the frames farther apart than 14 in. Lay a perfectly flat 1- or 1½-in. board across the lower members of the frame; place the veneered panel or other work on this; set another heavy board on top; and tighten the screws evenly. Blocks of hard maple with a shallow 1-in. hole in each may be used as shoes under the ends of the screws; and, of course, if the work in the press is not high enough for the screws to reach it, any available wooden blocking may be used.

When longer pieces have to be veneered, an additional section can be built, although two sections are sufficient for most work an amateur is likely to undertake.

For complete instructions on veneering, refer to Herman Hjorth's book How to Make Veneered Panels for the School and Home Workshop.

CHILDREN'S PANTOGRAPH FOR COPYING COMICS



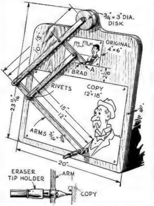
Small children find it great fun to enlarge comics with this device and then color them

THIS pantograph was designed especially for children from six to twelve years old, who are not yet able to manage the adjustable type. It has a ratio of three to one and will enlarge a 4 by 6 in. picture to 12 by 18 in.—just right for the Sunday "funnies."

Cut the base (preferably of plywood) to size, sand it smooth, and fasten a hub 3 in. in diameter by ¾ in. thick at the top. After giving the board a coat of thin shellac and sanding it, draw in with black ink the locations of the original picture and the copy.

The arms should be made of straight-grained hardwood, such as birch or maple. Put a thickness of paper between the arms while riveting and tear it out later to provide a little clearance. Oil the arms where they rub together. The remainder may be shellacked to keep the wood clean. The point *A* is made of a 1-in. brad, rounded off so that it will not dig in. The pencil holder is formed from a metal eraser-tip holder riveted in as shown. Use a No. 3 writing pencil or an H drawing pencil.

The pantograph is operated by guiding the point *A* over the lines of the original drawing, allowing the pencil to mark out the enlarged picture by its own weight.—D. A. P.



If the holes in the arms are bored exactly as shown, the device will enlarge three times

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ODD MACHINES PUT FUN IN MOVIES

(Continued from page 27)

plants large enough to yield the raw material for such imitations of hammers, chairs and other heavy objects used for playful socking on the comedy set. Lighter and more fragile than balsa wood, yucca is being widely used in place of it at West Coast studios.

After the sap has gone down, they cut the tall plants, which sometimes gain as much as twelve inches in diameter in a single season. Then they strip off the heavy bark and cut up the pith into boards. Yucca chairs retail for about $7.50 apiece, wine bottles for $7 a dozen, sledge hammers for $3 and giant wrenches for $5.

BECAUSE bottles, plates and other "breakaway" objects made of wax "go mushy" on the sound track, thin plaster is being used instead. It breaks with a realistic crash. Often, the side of such an imitation milk bottle is thinner than a sheet of this paper. The necks of the bottles, where the actors grasp them, are made heavier to withstand the pressure. Painted plaster-of-Paris plates, looking exactly like china, often weigh less than two ounces.

"When we make rocks," one veteran prop man told me, "we clean house, throwing in everything soft we have lying around."

The smaller rocks are formed of layers of newspaper covered with brown building paper and filled with excelsior and similar materials. The larger bowlders, such as roll down mountain sides to block the path of the villain, are likewise made of layers of paper. First, strips of brown paper are glued around a rattan frame. When they are dry, the covering is cut open and removed from the frame. Then it is glued together again and additional layers of paper are cemented in place over it. A "two-ton" rock of this sort could land squarely on your head without injuring you, since it weighs only a couple of pounds.

When a comedian stumbles through a glass door he doesn't really endanger himself. For the glass isn't glass at all, but candy. Thin, transparent sheets of hardened sugar and water look exactly like glass on the studio set and are widely used. Because of the fragile character of most breakaway objects, the propmakers turn out six times as many as are actually needed in a scene, to take care of accidental breakage.

In one recent comedy, the biggest laugh came from a trick shirt front. A pompous gentleman entered a room in full dress, unbuttoned his coat with a sweeping gesture, and his shirt bosom rolled up like a window curtain! The prop man who made it sewed a coil spring from a clock at either side of the shirt bosom. Unbuttoning the coat released the spring and permitted it to coil up again, rolling the shirt front with it.

A jumping-bean gag, which was the high point in another reel, depended upon the ingenuity of a propmaker for its success. In the comedy, a blundering actor fills a pot by mistake with Mexican jumping beans and puts it in an oven. Later, when he tries to taste the beans to see if they are done, they hop out of the ladle before he can get them to his mouth. The dipper was fitted with an interior spoon set on a spring. A wire, running down the handle and ending on a ring that fitted over the comic's little finger, enabled him to trip the release lever by a twitch of his finger, and send the beans flying.

ONE mechanical device, supplied as a comedy prop, worked too well for its own good. Several months ago, an eastern studio was filming a comedy about an eccentric inventor. He had devised a rocking chair with a motor attachment to do the rocking. In the play he pulls the wrong lever and the chair begins to hop around the porch like a hen on a hot plate. The chair, loaded down with gears, cams, and flywheels, appeared at the studio during the noon hour. By the time the camera was ready to shoot, the directors and actors had had so much fun riding the jumping chair that its machinery had broken down and it had to be sent back to the plant for repairs.

Queer inventions are always a fertile field for comedy gags. Scores of them have appeared on the screen in recent years. Of them all, the weirdest undoubtedly was the taxicab rigged up not long ago for a western production.

WHEN the driver pulled one cord, a boxing glove on a telephone extension swung out to indicate a right or left turn. A jerk on another cord started a fan revolving in front of the radiator and this in turn set in motion a mechanical hand which played a tune on a cornet to warn pedestrians. When a jaywalker was struck, the bumper automatically swung around, pivoting on one end, and swept the victim into the gutter.

To start the contraption, the driver pulled a cord which opened a feed box at the rear. A mule, hitched behind, started forward to get the oats and propelled the taxi forward. With the animal never quite catching up with the oats, the ludicrous vehicle rolled down the street.

Another puzzler that took some figuring out, was a horse that scratched its chin with its left hind hoof. Western prop-men finally solved the problem with one of the largest puppets ever filmed. This huge horse had twenty-one wires leading up into the rafters of the big sound stage. Here "puppeteers" operated the wires that gave life to the imitation animal.

Not infrequently, sound plays a big role in making the comedy picture funny. In a film recently released, the comedian steals barefooted down a long hall carrying a sack of roofing nails which he intends to scatter in a rival's bedroom. As he tiptoes along, the nails pour in a steady stream from a hole in the bag. Since the microphone could not be held close enough to the falling nails to record the sound at full strength, a record was made later and dubbed in at the proper place. In making the record, a technician poured the nails into a metal container.

Lifelike dummies of papier-mache and other materials are often used to replace comedians in dangerous situations. Usually, they are photographed from a distance. But, in one film, at least, a dummy of this sort was shot at close range. In a train wreck, a dog rushes up to what appears to be its master and grabs a leg in an effort to pull him out. The leg stretches and stretches and stretches. Rubberized cloth permitted this ludicrous anti-climax to a tense scene.

Oftentimes, the dummies serve as "standins" for actors, taking their positions under the hot lights until the director is ready for action. Because of the effect of the heat and light upon real foods, rubber asparagus, plaster-of-Paris fruit and papier-mache meats are turned out by propmakers to take the place of the genuine articles.

Virtually every comedy filmed these days depends for many of its laughs upon the skill and mechanical ability of prop men. Endless variety, rarely the same thing twice—that is the story of their work. The telephone rings; the mailman arrives; a telegraph messenger appears. And in comes an order that may be for anything from a twenty-foot monkey wrench to a dancing sardine—curious, laugh-getting mechanisms that form the strangest product list on earth.

PEARLS MADE TO ORDER IN ABALONES

(Continued from page 25)

worth considerable money. "Rose buds" are very rough but their exquisite coloring and iridescence place them among the most beautiful of pearls. It is possible for a clever jewelry designer to make fine pieces of art jewelry by using oddly shaped pearls. "Lilies," "leaves," and "petals" have been used in exquisite flower designs such as pansies and apple blossoms, until scarcity has made creation of these ornaments impossible. Such pieces with genuine pearls are now seldom seen but they are imitated in carefully cut pieces of shell. Daisy petals were made by using arrowhead pearls selected for size and color. Occasionally curious pearl formations occur. A Minneapolis jeweler owned a perfectly formed Madonna. Formations in the shape of a bird are sometimes found. "Acorn" pearls are not uncommon. A pearl dealer in Muscatine, Iowa, has a perfect pearl top which will spin on a glass show case. Such peculiar pearls may be mounted into "exclusive" pieces of jewelry by an artist with talent and inspiration, and then command high prices.

UNTIL Bostwick created large pearls in color, man had been unable to match nature in production of the rarer pearls, though Japanese pearl growers produced 600 pounds of true pearls each year.

Until a few years ago, nearly all pearls came from tropic and semitropic seas, most of them being brought up by divers in coastal waters off Asia from the Red Sea to Japan. Then Baron K. Mikimoto successfully produced perfectly formed pearls by selecting and cultivating pearl oysters. His is considered one of the most important scientific developments of modern Japan.

Baron Mikimoto plants the oysters in clear, clean water, whose temperature is above sixty-eight degrees Fahrenheit; on a clear bottom, over which the currents move sufficiently to bring fresh supplies of food. The pearl farms usually are located where there are no octopi or starfish, natural enemies of oysters. One of Mikimoto's "farms" is located in the waters of southern Shima in southeastern Japan. There he operates along a fifty-mile stretch of warm water.

In raising pearls, diving girls first collect young oysters, known as "spats," from the sea bottom. Sometimes even the floating larvæ are captured and the oysters raised. The spats then undergo an operation somewhat like those performed by Bostwick on abalones, in which the mantle parenchyma, a small sack, is removed. Into the sack a small bead of mother-of-pearl is placed. Then, the mouth tied, the sack is inserted into the shell-secreting epidermis of a second oyster. The oyster is then returned to the sea where in time it will cover the bead with several layers of nacre. The bead-bearing oysters are suspended in cages from rafts which are towed into protected bays when storms blow up. Seven years later the pearls reach maturity, when they are harvested, cleaned, sorted and drilled for stringing.

MIKIMOTO plants seven million oysters each year. One fifth of them die, usually as a result of the delicate operation; one fifth fail to produce pearls; three fifths yield pearls of varying values, totaling some 600 pounds in weight. Mikimoto owns seventeen patents covering not only the culture but also the cages and a method for controlling the luster of the pearls. Experts consider these to be natural pearls—all products of one man on ten submarine farms totaling 41,000 acres in extent.

Contrasted with this high degree of productivity, only one shell in a thousand brought up by pearl divers contains a pearl. Pearl fishers usually operate in forty feet of water in two-man teams. The diver descends with a stone weight, fills his basket, and then signals to his partner who pulls up the stone, the oysters, and finally the diver. Natives skilled in this hazardous work remain on the sea bottom from fifty to eighty seconds. One boat will take aboard as much as three tons of shells a day during the four-months season. Four-year-old oysters are those most sought-after.

TWO million people depend upon "natural" pearls for their livelihood. Nearly a half million engage in pearl fishing. The largest fleet has 50,000 naked divers braving shark-infested waters of the pearl banks of the Bahrein islands in the Persian gulf, twenty miles off Al Hasa on the Arabian coast.

These pearl fishers operate from high-decked dhows, as many as thirty-five divers going over the sides from a single dhow. Each carries a basket slung from his neck. He dives into an oyster bed and rapidly places pearl oysters into his basket until, out of breath, he signals the rope men to pull him to the surface. A good diver will gather forty oysters between breaths.

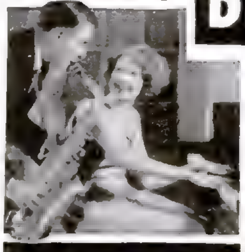
But the divers seldom reap any of the rich rewards of pearling. In debt to the dhow owners, they are virtually slaves to their employers. The fortunes usually go to the merchants around the Persian gulf, who produce from the folds of their often ragged garments bags of pearls, some of which may go to the marts of New York or Paris for the price of a king's ransom.

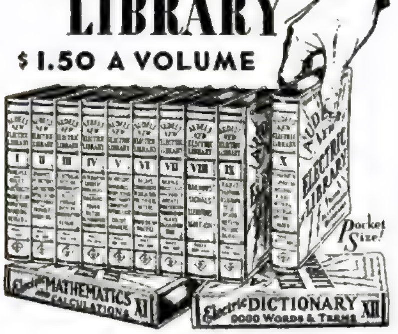
In the Dutch East Indies, adventurers from all countries seek pearls and pearl shell. Those with adequate capital go out on pearling luggers and employ East Indian divers to descend to the bottom. Diving is confined largely to the archipelago near Aros and Tenember islands, though occasionally some adventurous diver descends into the coral bottom which lies at great depth. One pearl diver recently returned from such a trip with arms and legs paralyzed from the extreme pressure.

THOUGH a pearl may lose "life", an expert can peel off outer discolored or flawed layers. In a few cases lustrous pearls have been restored in this manner, though they were somewhat smaller and less valuable than were the originals before they were dimmed by burial or accident.

Genuine pearls can not be cut or polished like other gems. It is a curious fact that the beauty and value of a pearl increases if it is constantly worn in contact with the skin. The slight moisture from a healthy skin, together with delicate friction from movements, tend to better the pearl and increase its luster. There are in India professional pearl wearers who sit and move about in the sunshine while wearing strings of pearls to enhance their value. Most professional pearl buyers have what are called "pet pearls" which they rub gently between the hands each day. When this is done regularly and properly, the luster is greatly improved and in some cases the value increases by one third to one half.

In relation to other gems, the distinctive characteristics of a true pearl are its luster and its subdued iridescence. It does not flash and glitter like a diamond, but has modest beauty. A fine gem pearl is a criterion of correctness and good taste and is worth, grain for grain, more than a diamond, ruby, or emerald. No new pearl fishery of consequence has been discovered during the last fifty years and fine pearls of size and quality are becoming so scarce that they are now in about the same class as Stradivarius violins.





PLANES THAT GO STRAIGHT UP

(Continued from page 15)

come to earth without crashing in event of engine failure, such craft never will be widely used.

The suggestions for attaining this end have been many. They range from having a collapsible balloon, which can be filled from a tank of compressed hydrogen in an emergency, to folding window-blind wings that the pilot can open by means of a lever. Most inventors, at present, are working along the line of variable-pitch propellers. These lifting screws could be shifted from a positive to a slightly negative angle during the descent. Thus the wind would turn them like the blades of a windmill and check the drop. In addition, just before reaching the ground, the pilot could shift the blades back to their most effective lifting angle and their momentum would produce an upward thrust that would slow the machine down before landing.

A VARIATION of this scheme is proposed by a young American inventor. He plans to have a gyroscope in the machine to keep it level in the air. In a descent, the heavy wheel of the gyroscope would be spun by the whirling blades and when the variable-angle screws were shifted back to their lifting position, the gyroscope would give them added momentum.

Of course, such proposals do not answer the problem of engine failure close to the ground. They are applicable only during a considerable descent to become effective. However, improvement in the landing gear, so it will absorb greater shocks, may take care of this problem. The experimental work with the autogiro has accomplished much in this direction. The modern machine of this type can touch earth without damage when it is dropping twelve feet a second. And, it is the shock of impact and not the fall that does the damage.

In the early nineteen-twenties, there was another burst of activity in the helicopter world. In 1921, the Marquis de Pescara, an Argentine of Italian descent, rode a twin-propeller craft into the air at Barcelona. It was equipped with a small body like a racing car, the engine and radiator being in front and the two screws, revolving at 200 revolutions a minute, overhead. Two years later, at Issy-les-Moulineaux, France, he set a world's record with a flight of approximately half a mile. On July 21 of that year, he achieved the first circle ever flown with a helicopter.

DURING that same year, Etienne Oehmichen, in France, and Dr. George de Bothezat, in America, also made helicopter history. Oehmichen, in a machine with four lifting air screws and a number of auxiliary propellers, won a prize of 90,000 francs by flying over a circular course of nearly a mile

In America, the U. S. Army financed the experiments of De Bothezat. His giant apparatus, measuring sixty-five feet from tip to tip, was shaped like a huge Maltese cross. It had a six-bladed lifting screw, twenty-six and a half feet across, at each of the four outer points. The framework, formed by a maze of tubing and wire, brought the weight of the craft up to 3,400 pounds. Yet, when it was tested at McCook Field, Dayton, Ohio, the apparatus not only lifted its own weight but 1,000 pounds besides. Its balance in the air was so steady that in one flight it lifted three men hanging from three of the four points of the frame. A hundred times, it ascended from the field and landed again without accident. The craft, on one occasion, was clocked at thirty miles an hour in a flight across the field.

Although De Bothezat's helicopter was one of the most successful tested, it flew only in perfect calms, and its provision for changing the pitch of the blades to provide for safe descents in case of engine failure was not tried.

The progress made in vertical flight during 1923 encouraged the British Air Ministry to offer a $250,000 prize for a helicopter that could pass four tests. The winning craft must rise vertically to 2,000 feet and descend, landing without damage. It must climb to 2,000 feet, hover over a given area for half an hour, descend and land without damage. The third test was a flight at 2,000 feet over a twenty-mile course at a speed of sixty miles an hour. For the final test, it had to descend from 500 feet with the engine dead and land in a circle of 100-foot radius.

ALL over the world, a weird array of "flying turtles," "sky windmills" and "aerial tunnels" were reported as being groomed to carry off the prize. But the time limit of the competition came and went without anyone fulfilling the requirements.

However, the Air Ministry has maintained its interest in developing a machine capable of vertical flight. In 1925, Louis Brennan, noted English naval inventor, was subsidized by the government in experiments with an original design. The machine is reported to have lifted 1,000 pounds and to have hovered over one spot for fifteen minutes.

Four years later, in 1929, another machine, the Isacco Helicogyre, was built experimentally under the auspices of the Air Ministry. It had a single huge lifting screw with air-cooled motors at each end equipped with smaller propellers that pulled around the lifting blades. A somewhat similar idea is incorporated in the Curtis-Bleecker helicopter, a $250,000 experimental craft produced a couple of years ago in America. Each of its four lifting blades has a propeller in front to keep the aerial windmill turning.

Two other machines, one in Italy, the other in Belgium, have marked further advances recently.

With twin blades spinning in opposite directions on a central mast, the D'Ascanio helicopter hovered and circled about over an air-field near Rome for more than eight minutes, early in 1931. Lighter than most machines of the kind, it weighs only 1,750 pounds and has a ninety-five horsepower motor. Smaller propellers at the outer edges of the framework aid in directing the craft and in maintaining balance.

The Belgian craft, designed by a mechanic named Florian, is lifted by a pair of twenty-four-foot screws, with a stubby auxiliary propeller spinning between them. Its curious landing gear consists of four shock-absorbing bumpers shaped like elephant hoofs. Rising higher than the surround buildings, the machine hovered aloft for almost ten minutes.

At the present time, a number of inventors are reported working upon the idea of combining a helicopter and a rocket. One plan is to have the lifting screws propelled by rockets, another, and more daring one, is to have the craft shot upward to a desired height as a projectile. Then, when forward momentum ceases, vanes, folded into the side of the projectile, open out and, propelled by an internal motor, carry the machine along as a helicopter.

In the search for the goal of vertical flight, noblemen, mechanics, famous inventors, unknown tinkerers, and noted scientists all have grappled with the problem. They have spent millions of dollars and patents innumerable record their ideas. Yet, so far, only tantalizing, partial success has been their reward.

It is no wonder, then, that men all over the world are awaiting eagerly the forthcoming trials of the English machine.

EXPERIMENTING WITH HOME CHEMICALS

(Continued from page 57)

the home chemist can wrap a cube in the cloth bag of the extraction apparatus and remove the fat by the carbon tetrachloride method. In this case, the salt will be left behind in the bag.

By making use of a simple substance like iodine, you can even determine chemically whether fruit is ripe or unripe. An unripe banana, for instance, contains a large amount of starch, while in a ripe banana the starch has been transformed into sugar by the ripening process. Naturally, a drop of iodine placed on a slice of unripe banana will form a dark blue spot as it reacts with the starch. On ripe fruit, the discoloration will not be as great.

When put to its ordinary use in the kitchen, gelatin is simply dissolved in hot water and allowed to cool. In a short time, it hardens into the transparent mass used in salads and desserts. If it is heated over an extended period, however, the gelatin will not only fail to set or gel but will be broken down into its component parts.

The effect of continued heating can be shown graphically in the home laboratory by making use of an interesting refluxing process. This consists of heating the solution in a round-bottom flask and allowing the distilled water vapor to pass up into a condenser. As it is condensed, it flows back into the flask and is reheated. In this way, the gelatin is kept at a temperature very close to the boiling point of water throughout the heating process.

At intervals of several hours each, some of the gelatin solution should be removed from the flask and tested. After a certain period of heating it will be found that the gelatin no longer will solidify and no amount of continued heating will cause it to gel.

Although a commercial condenser is shown in the photographs illustrating this experiment, a homemade unit improvised from corks, rubber tubing, and olive bottles can be made by following the drawings.

CHEMISTS MAKE WINE FROM CITROUS FRUITS

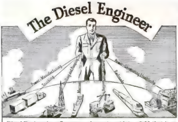
Seeking a way to use surplus crops of grapefruit, oranges and tangerines, government chemists have succeeded in making wines and cordials from this type of fruit. The body and flavor of the new wines are said to compare favorably with the finest products made from grapes. The wines are prepared by reaming the fruit, straining it and then fermenting it with a pure culture of wine yeast. Corn sugar is then added. Citrous brandy also has been made by distilling the fermented juice. Plans have been made to manufacture these new beverages commercially.

COMPASS NEEDLE POINTS OUT HUGE IRON DEPOSIT

Solution of a sixty-year-old mystery in connection with the magnetism of the Earth has led to the discovery of what is believed to be the richest body of iron ore in the world. Over a narrow strip of land, a hundred miles long, near the Russian town of Kursk, scientists who made a survey in 1874 discovered mystifying variations in the compass. The needle swung erratically first to the East, then to the West, and at times even to the South. Investigation disclosed the giant deposit.

THIS CROW WAS WHITE

A white crow is reported shot by a Gallipolis, Ohio, hunter. The albino bird was killed flying with a flock of black crows.



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CHEMISTRY MAKES SUGAR FROM BEETS

(Continued from page 39)

is not room, the diffusion will be equal in both directions.

The juice of the sugar beet is contained in tiny sacs, or cells, made of porous cellulose. When they are immersed in water, the principle of osmosis begins to work. The juice in each cell corresponds to the sirup in the sack which you tied to the end of the glass tube in your experiment. It is heavier in density than the water outside. Hence, the water begins to diffuse through the walls of the cell. There is no room for expansion inside the cell, however, and consequently, as the water enters, the juice is forced out. This process produces a much purer solution of sugar than the old pressure method, for many impurities are left behind in the beet cells. Very little sugar is left, however.

WHEN one of the big, iron diffusors in the sugar factory has been filled with beet noodles, it is sealed and warm water is pumped into it. A few minutes later, the water is drained off and pumped into the next diffusor, which is also filled with noodles. From the second diffusor, it goes to the third. Thus it continues through the entire battery, dissolving more and more juice and increasing in sweetness as it goes. The whole process requires about forty-five minutes from the time when a diffusor is filled with fresh noodles, until the noodles are exhausted of sugar and ready to be removed.

The juice-laden water, as it emerges from the last diffusor, is first measured, and then heated. It is now ready for liming. Every beet sugar factory is equipped with a huge lime kiln which is needed not only for lime production, but also for the production of carbon dioxide. The lime is mixed with water to form milk of lime, which is then added to the raw beet juice as it comes from the diffusors. About three parts of milk of lime are added to 100 parts of juice.

The action of the lime is to purify the juice. Another simple experiment will enable you to see for yourself just what takes place. Take a sugar beet (a carrot or parsnip will serve just as well) and pass it through a vegetable grater. Then let the mass stand in a cup of warm water for ten or fifteen minutes, stirring it occasionally. The water, of course, will diffuse into the plant cells, and the sugar will be dissolved out of them. Other substances will be dissolved too, however—substances which must be removed from the solution before the sugar is removed.

Drain your solution into a beaker and hold it up to the light. You'll probably see many little specks of vegetable fiber in it, but otherwise it will be clear. Now add several drops of milk of lime. The whole solution will turn cloudy white. The lime combines chemically, not with the sugar, but with most of the other substances which are present in the solution, forming insoluble calcium salts which will soon settle to the bottom of your beaker. To prove that the sugar is left in solution, fill another beaker with pure water and put a pinch of sugar in it. Now add several drops of milk of lime, as you did to your other solution. The sugar solution will remain perfectly clear. Therefore you see that the lime precipitates only the impurities in the raw beet juice as it issues from the diffusion battery. The sugar stays in it.

WHEN the juice has been thoroughly limed, it is treated with carbon dioxide gas in what are called carbonatation tanks. This treatment clears the solution of excess lime by precipitating it in the form of calcium carbonate.

These precipitations serve a double purpose. The first, which takes place when lime is added to the beet juice, does away with most of the impurities which have been in solution. It does more, however. If you watched the precipitate settle in your beaker, you probably saw that it carried down with it most of the specks of vegetable fiber and other particles that had been suspended in the solution when you first held it up to the light. The second precipitation, with the carbon dioxide gas, carries down still more of them. Thus the juice is purified both chemically and mechanically.

THE carbonatation of the juice must be watched very carefully, for if it continues too long, serious damage may be done. An expert tester is constantly on duty beside the carbonatation tanks. Every few seconds he draws a sample of juice and holds it up to an electric light.

"He watches for the precipitate to spin," my guide told me, as he explained the process in the Brighton factory. "Just wait here a minute, and you'll see it."

In less than a minute the tester drew a sample in which the white precipitate was swirling downward. Quickly he closed a valve, stopping the flow of carbon dioxide into the tank. The juice was now ready for the first Kelley press.

The Kelley press is simply a filter in which the juice is forced through heavy canvas mats to remove the calcium precipitates. After the first carbonatation and filtration, the juice is carbonatated and filtered a second time to further improve its purity. It is now a clear, brownish solution of almost pure sugar and molasses. The next step is to bleach it so that the sugar produced will be white, instead of brown. This is done with sulphur dioxide gas, which is made to bubble up through the juice. The gas combines with the water in the juice to form sulphurous acid, which is one of the most powerful decolorizers known to present-day chemistry.

This sulphur treatment completes the first phase of operations in the manufacture of sugar from sugar beets. The juice has been extracted from the beets, purged of impurities, and bleached. It is now ready to be cooked until the sugar crystallizes out of it. This is done in two separate operations. First the juice goes to the evaporators, where it is heated in vacuum. Then, after another sulphur treatment and another filtration, it goes to the boilers. Here it is boiled until it "sugars."

When the boilers are finished with it, the beet juice has been reduced to a heavy mixture of molasses and crystalline sugar. Now it goes to the centrifuges, which are big, hollow cylinders, spinning like giant tops, 1,250 revolutions per minute. Here the molasses is whirled through small perforations in the sides of the cylinders, while the sugar crystals are held inside. The sugar from the centrifuges is first dried, and then granulated in a huge drum that slowly revolves, rolling and tumbling the crystals until all lumps have been thoroughly disintegrated.

THE sackers are next in order. Approximately 600,000 pounds of sugar are sacked at the Brighton factory every twenty-four hours. To produce that quantity, almost 2,000 tons of beets are needed. One ton of beets produces about 300 pounds of sugar.

You have heard much about the gold mines of Colorado. You have read about rich strikes which changed poor prospectors into millionaires, almost overnight. Yet the fortunes in precious metals, which have been taken from the mountains of Colorado, are small indeed when compared to the wealth taken annually from the soil in sugar beets. This state produces more than one third of all the beet sugar made in the United States.

AIRPLANES HELP MINE GOLD ABOVE THE CLOUDS

(Continued from page 23)

gather speed for the takeoff. The airport is two miles above sea level, and the rarefied atmosphere requires a proportionately longer run and higher speed before we can pull back the controls and lift the seven-ton ship into the air.

Once up, we head for the crags which form a snow-covered rock barrier, 15,000 feet high, lying between Cuzco and the mine. A standard, two-way radio keeps us in touch with the ground. Meteorologists at Cuzco and Huanacopampa report shifts in weather. Mountain storms and treacherous winds among the peaks require constant vigilance. Beyond the ridge, we slide downward into the V formed by the two ranges flanking Huanacopampa. Our wheels touch at a mile a minute as we skim down the central chalk line. We roll to a stop and taxi to the hoisting mechanism at the far end of the field. Natives, sweating at the hand-cranks of the winches, hoist the load out of the plane and lower it to the ground. A few minutes later, we are off, shuttling back to Cuzco.

DURING the first thirteen days, we averaged four round trips a day. The heaviest load the ship ever lifted over the backbone of the Andes was a piece of machinery weighing more than 4,700 pounds, or nearly two and a half tons. Twenty-six mortar bases for the milling plant were hauled to the mine as a first step in the work. They averaged about two tons apiece. All told, we carried to the mountain top a complete milling, amalgamating, and cyaniding plant capable of treating 150 tons of ore every twenty-four hours. In addition, we delivered a hydroelectric plant capable of developing 750 horsepower, and miscellaneous machinery, equipment and construction materials.

After the heaviest pieces had gone through, a second ship joined the *San Fernando* in the work. It was the *San Felipe*, also a tri-motored passenger Ford with Wasp engines. As it was to carry only the smaller parts, we took out the seats and cabin fittings and loaded in the parts through the doors. Two other pilots took turns at the controls. They were B. Rickards and F. Sterling, crack Pan-American high-altitude flyers.

With both ships shuttling between Cuzco and the mine, work progressed rapidly. By September 15th, we had unloaded 245 tons of machinery at Huanacopampa. The mine engineers were assembling the parts, and the huge pile of freight at the Cuzco railhead was dwindling.

Our record for a single day's work with one ship was seven round trips and 25,500 pounds of machinery carried and unloaded at the plateau runway. In forty-five flights, we transported 175,659 pounds of steel. And, by September 26th, we reached the half-way point with 370 tons delivered.

To the Indians of the Huanacopampa region, our huge mechanical birds were a never-ending source of wonder. They came from points as far away as Puno on the shores of Lake Titicaca, to see them.

IN all, the metal ships made 459 flights and carried approximately 740 tons of heavy machinery. By the middle of October, we were cleaning up the odds and ends. And, on the last day of the month, the *San Fernando* and the *San Felipe* climbed into the air on the 458th and the 459th flights. They had delivered, without a mishap, all the machinery needed for mining gold above the clouds.

It was three-thirty in the afternoon when the two planes sideslipped down on the Cuzco field. Our work was over. We sent the home office at Lima the laconic radio message:

"Last trip . . . Cargo finished."

MODERN WONDER CAMERAS SEE LIKE CATS IN DARK

(Continued from page 41)

cellent pictures of friends, parties, or even of the waiters in action. Incidentally, one of the beauties of a cat's-eye camera is that it makes it easy to get action pictures, the kind that are superior to all others in lasting interest.

One of the first subjects that the owner of one of these remarkable cameras tackles is the nighttime street scene. He soon learns that brilliantly lighted theater signs and canopies provide the best sources of light, and that wet or snow-covered sidewalks aid materially in illuminating the subjects. Novel or attractive window displays offer worthwhile subjects. Interiors of busses, subways, trolley cars, and trains are now as full of photographic possibilities as the sunlit street. Dull days and stormy weather no longer prevent the photographer from obtaining unusual pictures.

THE so-called candid camera has proved valuable to news photographers and has offered new hobby possibilities to amateurs. A candid camera is simply one that is small and speedy enough to permit pictures to be taken of all kinds of subjects without the subjects' knowledge. A prominent man walking along a street, lounging in a hotel lobby, or testifying in court can be snapped by the candid cameraman. The candid-camera picture is wholly informal and therefore is more interesting and natural than any posed picture could be.

The business of "stealing" pictures has been developed into an art by news photographers and other candid cameramen. Sometimes ingenious tactics are absolutely necessary, if the photographer would escape with an undamaged camera and a whole head. More than one news-picture man has come to grief at a dog-race track operating in defiance of the law, or at some other place where photographs were not permitted, simply because he tried to get a picture with an ordinary news camera that cannot be concealed much easier than a piano. On the other hand, many a notable picture scoop has been made with a cat's-eye camera. Such cameras can be concealed in books, beneath coats, in packages, in hats, or disguised in any of a thousand other ways. Even without camouflage, a small camera can be used in such a way that no one will know a picture is being made.

The typical cat's-eye camera is not limited to nighttime picture making. It is equally useful in the daytime, or under any other conditions where photographs normally can be made. Even in competition with standard cameras of larger size, it frequently comes out ahead. Some miniature cameras can make pictures in such rapid succession that a series of shots showing the progress of an automobile mishap or other action can be obtained. Experienced operators are able to snap pictures less than a second apart.

IN THE field of animal photography, high-speed miniature cameras are capable of unusual work. Bad light conditions, rapid movement, and a spoiled shot now and then mean nothing to the camera with a lens ten times as rapid as the speed lens of a few years ago, and using film that costs little more than a nickel a foot or less than a cent a shot.

Photographers who go in for speed work and snapshots in poor light, frequently resort to tricks of the trade in order to boost the already great speed of their films. Hypersensitizing the negative material by chemical means may be resorted to, one method consisting of bathing the film in an ammonia solution for a short time, and then drying it as rapidly as possible. The speed increase obtained by such means is only temporary, so that the hypersensitized film must be used within a short time, usually a few hours, if maximum benefits are to be obtained.

Another method frequently used to increase film speed is pre-fogging. That is, the film is fogged slightly by action of light before it is exposed in the usual way. An increase of the density of the silver negative image of three to five times is claimed for this method. A convenient way to pre-fog a film is to set the camera shutter at a fairly high speed, say 1/100 second, and the lens diaphragm at a medium opening, about F/6.3; place a sheet of ordinary typewriter paper over the lens, holding it down about the edge of the lens flange; point the camera at the sky (not permitting sunlight to fall directly on the paper over the lens), and snap the shutter. Reset the shutter, without moving the film, and make the exposure in the usual way. At night, pre-fogging can be accomplished with the aid of an electric lamp.

PROCESSING films and making prints at one time presented a problem in cat's-eye photography and other camera work involving very small films. Today, though, there are thousands of amateur photographers who think nothing of turning out eleven- by fourteen inch enlargements from negatives the size of one of the new National Park postage stamps.

Manufacturers have concentrated on the making of fine-grain films, in which the minute particles of silver forming the photographic image have less tendency to clump together into grains than in ordinary films. Various fine-grain developers have come into use. Among them is a group employing paraphenylene-diamine, a chemical that used to be found in hair preparations but which was discontinued because of its poisonous effects on the skin, and which is now employed widely in the rubber and many other industries.

In addition to employing a fine-grain film and developer, the cat's-eye cameraman has to be a bit fussy about the handling of the film. He has to keep the temperature of the various solutions and rinse water constant throughout, and then be careful not to chill the film when he attempts to dry it. He has to swab it gently with some soft material, such as one of the new viscose sponges, to remove scum and particles of dirt that might look as large as potato bugs in enlargements. After the film is safely dry, it must be handled carefully to avoid finger marks, scratches and dirt accumulation. Usually, special enlargers, designed to minimize grain and accommodate small negatives, are employed for printing.

THE cost of a good quality cat's-eye camera, equipped with the fastest lens that is practical, may take your breath away, especially since the outfit is not much larger than a pound of butter. Yet the abilities of that camera, coupled with its low-cost operation, frequently make it a profitable investment. The photographer who seeks to make money from his hobby or profession can make such a camera pay for itself many times over. Proof of this is seen in the fact that many free-lance photographers who sell pictures to magazines and newspapers, as well as professionals who specialize in baby pictures or other difficult branches of photography, are finding markets for miniature-camera pictures consistently. They produce good results in almost every field of photography.

You will hear much about cat's-eye cameras in the future, and see increasing numbers of pictures made with them.

COIL-WINDING TRICKS FOR SET BUILDERS

(Continued from page 59)

Another method, and one which must be used when the spacing is wide, consists of marking just where each turn should go on the coil form and then applying the wire accordingly. By using either of the two winding kinks already described, the wire can be wound to the marks easily and will fall automatically into a well-formed spiral around the form.

Fiber coil forms are not always used as the cores for coils. They may also be made to serve as containers for protection of the actual coils. In this case, the coil is wound on a small-diameter tube and slipped inside the regular form. This is a particularly handy arrangement in portable sets where the coils are sure to receive hard use and if left exposed may be broken or injured. The outer form is then supplied with a handle which also serves as a cover.

VERY often, the amateur finds that although he has a complete set of coil forms on hand they are not of the exact diameter specified for the particular receiver he is building. Within certain limits, however, he can alter the winding specifications to agree with the diameter of the forms he has available. If the difference is not more than twenty-five or thirty percent, the number of turns in both tickler and grid winding will change inversely as the ratio of the two diameters while the change in the spacing between the two windings will vary directly as the ratio of the two diameters. This, of course, takes for granted that wire of the size specified is used.

For instance, let us suppose that a coil is specified as consisting of a thirty-turn grid winding spaced one quarter inch from a five-turn tickler on a form one and one half inches in diameter and it is desired to wind the coil on a one- and one-quarter-inch form. Applying the proportions, the tickler on the smaller coil will have six turns (5 multiplied by 1½ and divided by 1¼), the grid winding will have thirty-six turns (30 multiplied by 1½ and divided by 1¼), and the spacing between coils will be reduced to two tenths of an inch (¼ multiplied by 1¼ and divided by 1½).

Changing coil specifications, however, is always risky business. As far as the beginner is concerned, it will be better to wind the coils exactly as indicated even though it may mean additional expense. Plug-in coils are the heart of the simple regenerative short-wave receiver and unless they are accurately designed and wound, even an expertly wired circuit will fail to give good results.

PIGEONS TO BE DRAFTED FOR THE NEXT BIG WAR

AN ARMY of American homing pigeons, a million strong, may be drafted in the event of war. Plans are reported to have been worked out dividing the country into zones with an officer in charge of each to keep in contact with all owners of pigeons, so that the birds can be mobilized in the shortest possible time. During the World War, pigeons played an important part in carrying messages from line officers to headquarters.

ONE FIFTH HORSEPOWER DRIVES MODEL AIRPLANE

WITH a tiny fuel tank holding one and a third ounces of gasoline, a six-foot model airplane takes off, flies, and lands, powered by a miniature motor developing one fifth of a horsepower. The model was designed and built by Paul Karnow, an eighteen-year-old boy of Philadelphia, Pa.

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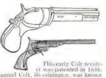
INTERESTING INVENTIONS

An Early Revolver



This early Colt revolver was patented in 1836. Samuel Colt, its originator, was known as the boy inventor. While still a lad he ran away to sea and whittled the first model of a repeating fire-arm out of wood during his leisure moments on shipboard. Colt was persevering. Three years later, in 1839, he had made improvements to produce the second revolver shown here. It was used in the Mexican War with excellent effect. By 1852, Colt had the largest firearms factory in the world. Colt died a very wealthy man.

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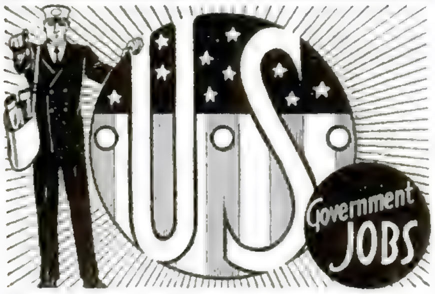

HERE'S THE ANSWER

(Continued from page 61)

physical endurance, greater resistance to disease, and a better defense against nervous and mental disorders than those who are underweight.

What Is the Decibel?

J. A. L., WATERBURY, CONN. A decibel is one tenth of a "bel," the standard transmission and sound unit named after Alexander Graham Bell, the inventor of the telephone. The bel does not indicate any specific quantity but is merely a convenient means for expressing a loss or gain ratio for indicating the actual differences in power levels as in the changes in the volume of a sound.

Primary Prismatic Colors

W. J. B., ALEXANDRIA, S. D. Only three of the seven colors of the spectrum are considered as being primary colors. These are red, green, and blue. In pigments, however, the three primary colors are red, yellow, and blue.

A Drop's Volume

Q.—JUST how much liquid is contained in the average drop formed at the end of a medicine dropper?—V. N. B., Jr. Portland, Ore.

A.—THE volume of the average drop can be considered as being equivalent to one twentieth of a cubic centimeter. Similarly, one cubic centimeter equals about twenty drops.

Columbus and the Elements

D. F. T., ST. LOUIS, MO. When Columbus discovered America only eleven of the recognized elements were known, eight of these being metals. In fact, it was not until two hundred years later that the twelfth—phosphorus—was added to the list. The remaining eighty of the ninety-two known elements were discovered during the past two hundred years.

Asks About Asteroids

T. Y. O., HONOLULU, T. H. There are two schools of thought regarding the asteroids revolving about the sun in orbits adjacent to Mars and Jupiter. The first holds that they are the fragments of an exploded planet. The second contends that they are the makings of a planet that never formed. Up to the present, about 1,100 asteroids have been discovered, the largest being about five hundred miles in diameter.

Fourteen Diseases Conquered

H. G. C., MEMPHIS, TENN. Of the thirty-two so-called chief diseases, fourteen could be wiped out entirely if the existing medical knowledge concerning them was put into rigid use.

Removing Match Scratches

Q.—CAN you give me a formula for a polish that will remove match scratches from furniture?—F. D. V., Oakland, Calif.

A.—MATCH scratches on woodwork generally can be removed by rubbing them with a slice of lemon, following this with some powdered whiting, and finally with a soapy cloth.

Car Backfires On Hills

I. C., BROOKLYN, N. Y. One trouble that often causes a car to backfire when it is coasting down hill with the throttle closed can be traced to spark plug points that are too close together.

WHEN YOUR MOTOR MISSES

(Continued from page 62)

but as soon as he tried a trip it ran dry.

"The first time it happened, he thought he'd got some dirty gasoline, so he had the gas line cleaned, threw out three quarters of a tank of gas, and filled up with fresh. It looked like he had it licked until the morning he came in here at the end of his neighbor's tow rope. He was fit to be tied and blamed the gasoline again, but the joke was on him."

"What was the matter? Empty gas tank?"

"WORSE than that," Gus chuckled. "About two weeks ago, he lost his gas-tank cap, so he went to an auto-supply store and bought a fancy, nickel-plated affair. He didn't know there were two kinds and bought one without a vent hole in it. Having a vacuum-tank car, he should have got one with a vent hole. Naturally, the vacuum tank couldn't suck against the vacuum formed in the gas tank so it ran dry. In the city, where he made short runs, the car generally was idle long enough between times for air to leak in around the threads and equalize things, but on long trips, it was just too bad."

"What was the second job?" asked Withers.

"That was a funny one, too. One of our best customers took a long trip about a week ago. Everything went fine until his feed line started to act up. Every hundred miles or so it would get clogged and he'd have to stop and have it blown out. Dirt was getting into the gas tank in some way, but none of the garages along the road could locate it.

"When he got home on Tuesday, he came in here. I had a hunch, and took the tank off the chassis. As I was lifting it up on the bench I heard a peculiar rattle, so I started fishing around inside the tank with a couple of long wires. It wasn't long before I pulled out three feet of rubber tubing."

"Rubber tubing?"

"Sure. He probably had his car parked some place and a gasoline thief tried to siphon off the gas. Something scared him, and instead of pulling the tube out, he dropped it. After that, it was just a question of time until the gasoline started to attack the rubber and break it up into small pieces."

"Are gas troubles the only things that can make a car sputter and miss?" asked Withers.

"Not by a long shot. All sorts of things can happen to make a motor miss, but you generally can trace them by noticing when it misses the most.

"IF IT misses at high speed, but runs pretty smoothly at low speed, it's likely to mean that the breaker points are set too close, that the spark-plug points are too close together, that the high-speed mixture in the carburetor is wrong, or that the valve springs are weak.

"Lots of cars miss at low speed, but run fine at high speed," added Gus. "In that case, the spark plug points may be too far apart, the breaker points may be too widely spaced, the choke may be stuck, the manifold may leak, or the valves may be worn."

"But what makes a car miss at all speeds?" asked Withers.

"A whole mess of things can cause that. Poorly adjusted valves, stuck valves, dirt in the carburetor, a plugged fuel line, leaks in the ignition wiring, bum spark plugs, a cracked distributor head or rotor, or a poor carburetor mixture."

Just then, Joe Clark, Gus's partner, poked his head through the door. "Ned Hoffman just drove in, Gus," he called. "Wants you to take a look at his engine. Got a bad sputter, and thinks maybe one of the spark plugs is fouled."

"What did I tell you?" grinned Gus. "Number four and it's only Wednesday. This seems to be the week when the Model Garage is the port of missing motors."

[redacted]

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Elevators To Carry Fish Across Big Dam

(Continued from page 17)

continuous operation—while the water is lifting the fish that have entered one lock, other salmon, guided by an outward flow of water which they will swim against, can be entering its companion lock. A movable cage, with a slanted bottom, will lift the fish to the upper level when the inlet pipe is opened, and on arrival there give them a gentle impetus to swim through the passage leading into the channel above the dam. A single fish lock, for emergency use, is placed at the south end of the spillway trap. These will be the first locks ever built for fish.

EACH of the fish ladders, and each pair of locks, is capable of handling an entire day's run of salmon as it arrives, or sections of the day's run can be diverted into the various fishways as desired.

Experiments now are being made to determine whether the young salmon will need help over the dam on their downstream journey to the sea. As the power house will use large, low-speed power wheels, it is thought that the young fish will be able to pass through without injury. However, surface bypasses will be provided in case the fingerlings are reluctant to allow themselves to be carried down either through the power wheels or under the spillway gates.

The design of the fishways over the Bonneville Dam to safeguard the Columbia River salmon is just one of the many ways in which the scientists of the Bureau of Fisheries are trying to better fisherman's luck, and to take a large proportion of the element of luck out of fishing—especially out of commercial fishing.

Although even the sport of angling has an important economic aspect—it is estimated that, counting the cost of tackle, transportation, and so on, every game fish caught by a sportsman is worth a dollar a pound!—a bad day doesn't matter so much to the fellow who goes fishing for fun. But a bad season in the great commercial fisheries is an economic tragedy to a great many people. For, in one way or another, a half million Americans depend on our fisheries for their livelihood.

One of the important duties of the Bureau's scientists is to discover early signs of the depletion of species of fish that are of commercial importance, and to recommend to commercial fishermen and to the states directly interested, measures to check the depletion. Another important duty is to forecast for the benefit of commercial fishermen the probable size of the coming season's catch, so that preparations may be made for handling and marketing a large catch if one is likely, and so that money may be saved in the fitting out of fishing vessels and the making of handling preparations if the season is likely to be a poor one.

To carry out these duties, constant study of the fish life in large areas of the sea is necessary. The Bureau's seagoing scientists are the census takers of the deep. They aren't able to count every fish in the sea, of course, but by keeping close track of spawning conditions and of the total catches of each variety of fish they are able to estimate closely how well the various populations are being maintained, and what the coming season's catch is likely to be.

Few salt-water fish "stay put." From the beginning to the end of their lives they keep moving from place to place. Even the eggs of marine fish always are on the go. Deposited in the open sea, they are carried along by the currents, a part of the dense drifting life called "plankton" which is the chief basic food of most fish. After they hatch, the young fish continue for a time to drift with the current, feeding on the plankton of which they lately were a part, and in turn preyed upon by larger fish. When they are strong enough to swim where they please, they start their endless migrations in search of food, and in obedience to the laws of their kind.

For several years, Bureau investigators have been tracing the drift of the eggs of haddock, weakfish, mackerel, and other important food fish, by means of experimental hauls with fine silk nets. A single cast of one of these small nets has been known to bring up a half million weakfish eggs.

Valuable information about the growth and migrations of more mature fish is obtained by catching them, recording their measurements, tagging them with numbered tags, and returning them to the water. A proportion of these tagged fish are caught at later dates—sometimes several years later—and, as requested on the tags, their measurements, with the date and place they were caught, are sent to the Bureau for checking against its records.

Until recently all methods of tagging were more or less unsatisfactory. Metal tags clamped on a fish's tail were so heavy that they interfered with the fish's movements, and sooner or later wore through the flesh and fell off. Tattooing a number on the fish's side, and branding with dry ice, were tried, but neither method resulted in a marking that was permanent. Then Robert A. Nesbit, associate aquatic biologist in charge of Atlantic investigations, solved the problem. He makes a small incision in the fish's body wall, inserts a brightly-colored tag of celluloid or soft rubber in the body cavity, and returns the fish to the water.

IN FISHERIES investigations it often is desirable to know the exact age of an individual fish. Size gives a rough indication, but size is not always a true index to age, as adverse conditions may keep a fish from growing as rapidly as the average of its kind. The scales are a much more trustworthy guide to its age.

If you examine a fish scale under a microscope, or even under an ordinary magnifying glass, you will notice numerous ridges, something like the growth rings in the section of a trunk of a tree. Ridges close together represent a period when the fish was growing slowly; ridges widely separated represent a period when it was growing rapidly. This makes it easy to determine a fish's age.

In 1932, the latest year for which full figures are available, the total catch of fish in the United States and Alaska was over two and one half billion pounds, and in spite of low prices it was sold for over $54,500,000.

That our fisheries, after centuries of intensive fishing, can still produce this much wealth, is largely due to the conservation methods of our Bureau of Fisheries. In Alaska, where the Bureau has the power to regulate all fishing, the value of its work shows up most clearly.

THROUGH agreement with the Canadian government, the seriously depleted halibut fishery has been regulated so as to bring it steadily back toward normal. Another case in point is the fur-seal herd of the Pribilof Islands. When it came under the Bureau's control in 1911 there were only 200,000 seals left after many generations of ruthless slaughter. Now the herd numbers 1,300,000, and is increasing at the rate of eight percent a year, although over 50,000 surplus males are being killed for their skins annually.

On the coasts and inland waters of the United States, where the Bureau has no regulatory power, conservation methods recommended by it have been adopted by many states and by many commercial fishermen. Especially effective has been the use of saving gear by trawlers—large-mesh nets that allow fish below market size to escape.

The work of the federal fish hatcheries also is making for good fishing in the future. In 1933 these hatcheries produced and distributed over seven billion eggs, fry and fingerlings. Two percent of them were game fish, the rest food fish. Another important conservation measure was the rescue of fish stranded in shallow pools after the Mississippi floods.

One of the Bureau's many jobs is seeking new uses for fisheries products. Experiments made recently in its technological laboratories show that swordfish-liver oil contains from fifteen to twenty-five times as much vitamin A, and from seventy-five to 100 times as much vitamin D, as does standard cod-liver oil. This discovery probably will mean the expansion of the now comparatively small New England swordfish fishery until its product is worth about $5,000,000 a year.

And the laboratory work of the Bureau's scientists does more than find new ways of putting dollars into fishermen's pockets. It finds ways of keeping their dollars *in* their pockets. In the past, out of every dollar that a fisherman was paid for his catch he had to spend twenty cents to replace his nets. Chemical net preservatives recently developed by the Bureau have made it possible for fishermen to save two million dollars a year on net replacements. Years of scientific study of the salmon have made it possible to regulate commercial fishing so as to produce the greatest possible catches for fishermen, while at the same time allowing enough fish to spawn to protect future runs in the various rivers.

Inflated Hides Used as Boats

LOOKING strangely like rubber animals that children take to the beach, these odd boats are really hides of bullocks blown up with air and used by natives of India for getting across streams. The picture was made on the bank of the Sutlej, near Simla

The difference between day and night!

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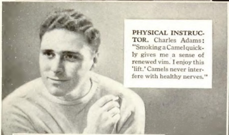

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